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Bottle Making in Indo-China

An Account of Glass Manufacturing Conditions in the Far East

By Donald Robertson

In dealing with the manufacture of glassware in Indo-China, the writer feels that he cannot do better than to say a few words of the country itself.

Indo-China, the most important of the French colonies virtually consists of five different countries. In the south the colony of Cochin-China and the kingdom of Cambodgia appear to offer an interesting field for exploitation. Annam in the east is thinly populated while the laos or hinterland with the kingdom of Luang-prabang appears to be rich but undeveloped; this, however, may be altered when the Mekhong at Thakkek is linked by rail with the sea at Vinh. The river Mekhong which rises in Tibet is something over 2,000 miles in length but unfortunately though broad the current is very rapid in places and navigation is rendered difficult and dangerous by the presence of shifting sandbanks and rocks. In the north the province of Tonkin is rich in coal and many minerals and has a large population. The population of Indo-China is 20,000,000. The climate is exceptionally damp and many classes of goods such as rubber tubing, etc., are spoiled rapidly when stored.

The Glassworks of Indo-China

CHINESE. There are a number of small skittle pot manufacturers who are almost entirely Chinese or of Chinese extraction. They melt about 500 pounds of glass at a time from cullet in a refractory pot, on a small open hearth furnace. Occasionally soda is employed for fluxing the cullet but otherwise raw materials are rarely used. Prices vary from $ Mex. 45 per ton for white cullet to $30 per ton for green cullet. It is estimated that the combined production of these manufacturers is 10,000 bottles, flasks and vials per day. It is unlikely that any one of them ever receives an order for more than 1,000 articles of any particular nature. They use wooden molds, blow by hand and they have a maximum output individually of 600 articles a day for small 2 ounce medical ware.

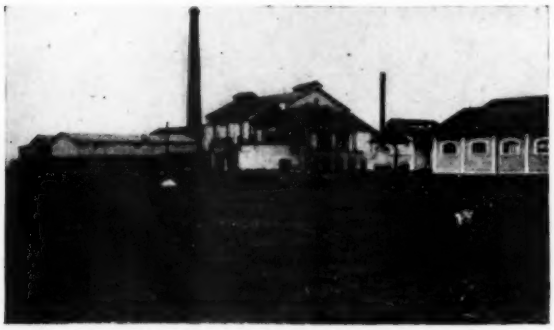
SOCIÉTÉ FRANÇAISE DES VERRERIES D'INDO-CHINE. This company is the only one at present in Indo-China making bottles by a mechanical process. It was established 18 months ago and owns the Cong-My Glass Factory built in 1916. The factory is situated at Cong-My seven miles from the port of Haiphong and has been in full operation except for two hot repairs since March, 1924. The tank is expected to shut down for big repairs in June, 1925.

This factory will be described further on.

SOCIÉTÉ FRANÇAISE DES VERRERIES D'EXTREME ORIENT. This company has recently been formed, and is well supported financially. It is to be equipped on modern lines. The company has secured a good position and is to manufacture window glass. They also purpose making bottles on

POT ATTACK

two modern O'Neill machines. The company is associated with the very well known French group, the Société des Glaceries de St. Gobain, Chauny et Cirey, and with the Société de Chimie de l'Extrême Orient, and further, they have an interest in the local distilleries. Their furnace should be completed in the course of a month or two and they should be making bottles by the end of August. The manager is a former manager of the Société Française des Verreries d'Indo-Chine, referred to above.



VIEW OF THE GLASS FACTORY

TRANSPORTATION TO MARKET IS BY MEANS OF JUNKS.

Bottle Making at Cong-My

The plant consists of a small tank furnace without a bridge, 24 feet by 13 feet with a 3 foot depth of metal. Its theoretical capacity is 70 tons and 16 tons of glass are drawn from it daily. Eight Boucher machines are employed to make the bottles—one gatherer to two machines, and an average of 330,000 good quart bottles per month is obtained. The furnace is operated by Annamite labor about which mention will be made later. The furnace is of the ordinary Siemens cross flame, regenerative type with 5 small rectangular dry bottom Siemens producers having a total grate area of 64 square feet. At present 3 gas producers are employed gasifying 8.83 tons Japanese coal per 24 hours. The company makes its own electricity. Two old Marshall compound engines of 70 H.P. each are used alternately to drive a Farcot dynamo, maintaining a direct current voltage of 220 volts. The following motor power is used in the plant.

Limestone crushers and grinders	10 H.P.
Compressor	7 H.P.
Ventilators and fan blowers	14 H.P. (2 at 7 H.P.)
Water pump	7 H.P.
Workshops	7 H.P.
Electric lighting in works and domestic purposes in Europeans dwellings	5 H.P.
	50 H.P.

A fairly large workshop has to be maintained owing to the difficulty of procuring ironmongery, etc. The company makes all its own molds from local castings; these latter are frequently of very inferior quality, full of blowholes and other defects. Even with good castings, the native workmanship leaves much to be desired.

The lehr is of the ordinary pan type but the bottles are stacked up on the pans instead of being placed upright. The lehr takes 12 hours approximately to go through and the annealing is pretty good.

A narrow gauge line connects the work with the river but most of the transport is done by women who carry a round basket suspended at each end of a long pole. In this way coal is brought from the junks or barges on the river to the coal dump and bottles are taken down to the junks in which they are transported to their destination.

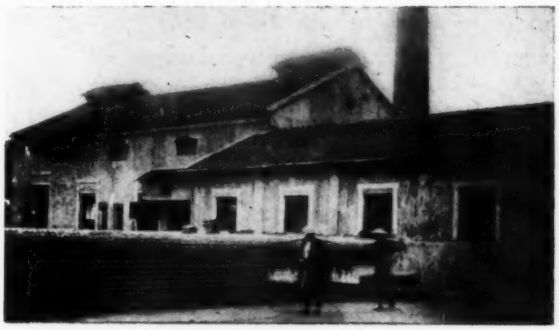
LABOR. The labor is of a somewhat inferior description. The Annamite is weak and tubercular, timid and indolent, superstitious, a liar on principle and a thief by practice. His world is peopled with devils. In nearly every mechanical contrivance there is a "maqui" or devil; and this belief leads sometimes to absurd and sometimes to extremely annoying complications. I have known blowers to offer gifts of rice and alcohol to their machines, and one blower was caught pouring native alcohol into the inverted parison mold. His excuse was that he was giving the devil that blew the bottles on his machine a drink because the latter was getting very hot and tired and commencing to blow bad bottles, yet this coolie had been a blower in the factory for five years! Sometimes the consequences of this superstition are more serious and on two occasions there has been a stoppage due to this cause. A few days ago it was impossible to get anyone to work on the furnace for twelve hours owing to a "devil" in the compressor, and not for any money can a coolie be got to stay out during a whole night on the river in the writer's motor boat because of the "devil" in it. Recently owing to the heavy rains and to the use of wet sand, the writer was troubled with batchy metal for a couple of days. The natives attributed this to the anger of the devil in the furnace, and so they held a prayer meeting to beseech the evil spirits to desist.

Each man is paid on the output from his machine or machines, in fact so far as possible the writer has endeavored to make everyone in the factory interested in his output.

Thus the gatherer is paid according to the number of good bottles made on the two machines for which he gathers. The blower is paid by the number of good bottles on his machine. Blowers and gatherers earn about $ Mex. 30 per month, but if they should attain what would be normal practice on the same machines in Europe or the States they could earn about $ Mex. 70 per month. The mechanic and shift foreman on each shift are paid according to the production of their shift.

Batch mixers, founders, etc., are paid a fixed wage plus a rate varying with the number of tons of glass melted per month. Bottle sorters have a premium at the end of the month which depends on two factors: the number of bottles rejected by the inspectors on each delivery of bottles, and by the number of times on which the supervisors have found a passable bottle rejected. A sorter receives roughly $ Mex. 15 per month. Coolies receive $ Mex. 10 per month, but most work is done by task through a contractor. The secretaries and interpreters receive a small bonus on the month's production. Boilermen have a premium for regularity in boiler

THE MANAGER'S HOUSE.



THE TRANSPORT PROBLEM.

pressure. It was not found possible to pay them according to coal burnt, with a premium on coal saved, owing to the varying quality of coal received. Fitters and smiths are given a small premium from observation of their work. In awarding such premiums the manager takes into account his own observations, those of his two European supervisors and the opinion of the Chinese foreman in charge of the fitting shop. In the case of all these premiums, the manager's decision is absolutely final and there can be no appeal against any award made nor has the worker claim to more than his fixed salary. All of the workmen employed in the glass-works are entirely Annamite with the exception of the Chinese foreman above mentioned.

The European staff consists at present of the writer with two Spanish supervisors. There is also a French commercial manager at the company's registered office in Haiphong.

Fuel Supply

Although coal is mined locally it is highly anthracitic with only 7 per cent volatiles at the most. The Indo-chinese coal is with few exceptions surface mined--much of it is sold as slack. This coal costs about $ Mex. 11 per ton at the glass works and is used on the boilers. For the gas producers Japanese coal which costs at the works about $ Mex. 18 per ton is used. This price includes of course the cost of importation and import tax. There are no local oil wells, and there is no natural gas. Crude oil is purchased when required either through the Standard Oil Company of New York or through the Société France-Asiatic des Pétroles. The same applies to cylinder and lubricating oils.

Refractory Materials

This constitutes the principal problem with which this company has to deal, for all tank blocks, silica and aluminous refractories have to be imported from France, and the difficulties and delays in ordering materials and in getting them out to Indo-China has frequently been responsible for considerable loss to the company. Since the writer's arrival a vigorous search has been made for local refractories and at one time it was thought that the efforts made were to be crowned with success. A plastic clay, blackish grey in appearance and apparently containing no iron or very little was found at a depth of 200 feet below the surface and immediately above a coal seam. Blocks of this material were made and slowly fired and finally tested by immersion in the tank furnace. At the end of five days the blocks had completely disappeared.

The batch composition used was as follows:

Sand	2350 kilos	
Lime	900 "	(ground limestone)
Soda Ash	625 "	
Salt Cake	150 "	

This attack could not be accounted for. An analysis of the material in question was sought from the Government laboratories in Indo-China but since two analyses of the same sample gave widely divergent results in the matter of iron and alkalies they cannot be considered as final. The search for suitable refractories is still being pursued, careful records being kept of clays sampled and tests made.

Raw Materials

Sand is quarried locally at a distance of about 25 miles from the factory and brought to the works in junks or barges. It is fairly white but the deposit is isolated and offers difficulties in transport. The sand costs $ Mex. 1.80 per ton delivered at the works. The iron content is about 0.3 per cent which for all practical purposes renders it impossible to make white glass.

Limestone offers another source of annoyance to the glass-maker for there are no regular deposits. The geologic formation of the country is somewhat peculiar, consisting as it does of an immense alluvial plain out of which there start like islands calcareous rocks at certain points. The stone is extremely hard resembling marble but grey and granulated. It is used in laying foundations and for road metal, also by the cement factory. Among these rocks are found certain small deposits of a yellow limestone which give an almost streaky bacon effect to the black or slate colored rocks. This limestone is brought to the works where it is first crushed to small fragments, then ground and sieved. Samples of the ground limestone contain about 0.2 per cent Fe_2O_3 and stone delivered at the works cost about $ Mex. 2 per ton.

Soda ash and salt cake are imported from France, and by the time they are delivered at the works they are necessarily very expensive. Soda ash costs about $50 gold or $ Mex. 85 or £11 stg. when delivered at the works.

In calculating costs a rough relationship can be obtained if $ Mex. 1 is taken as equal to 50 cents U. S. Currency or 2 shilling and sixpence British money.

THE AUTHOR AND THE CHINESE FOREMAN.

MELTING FURNACE AND BOUCHER MACHINES.

Production

The native labor employed on the Boucher machines leaves much to be desired. The gatherers even after eight years employment with the company are not able to judge the weight of a gather; as a rule they will gather at least twice as much as is required and they pour off their irons the excess glass into the cullet tubs beside each machine. The most common fault is gatherers' blisters, which account for at least 50 per cent of the bottles rejected in sorting. Molds are another source of trouble. Castings are made locally and machined at the glassworks and it is only with difficulty that the fitting shop can supply the demands made upon it. Batch and cullet are both carefully weighed before filling-in, in order that a definite proportion of cullet to batch should be maintained. The quantity of glass melted was found to differ very widely from the quantity of total bottles carried through the lehr. A careful investigation was therefore made lasting over several days. The normal working efficiency was found to be as follows: Of the 16 tons of glass drawn from the furnace daily, ¾ of a ton was lost around the furnace, 2½ tons in moils, etc., 1¾ tons was thrown out at the machines.

The remaining 11 tons went through the lehr where ½ a ton was broken, and rejects amounted to 2 tons, leaving a net production of 8½ tons, or 13,000 good bottles. This result was somewhat startling and would appear to indicate a good deal of inefficiency, but it is questionable whether the inefficiency is so great after all. The manufacturing results shown are neither good nor bad, they are average. During three months an average of over 14,000 good bottles daily was obtained whereas 13,000 is shown. The figure of 15,000 in 24 hours has been reached and passed. The Annamite is a filthy worker and he cannot be got to work quickly, an iron will not serve him for more than three gathers for each machine, six bottles in all, hence the wastage of metal. Many bottles are also thrown out at the machines due to bad molds, short weight, "not blown up" "not filled up," and a large variety of other causes. The principal causes for which bottles are rejected in sorting are, blisters, thin sides, ring mold troubles, twisted necks, etc.

The illustration shows the Annamite sorters at work. They cannot sort while standing up, and although sorting tables were installed at the end of the lehr to make the workers more comfortable and efficient they were never used.

The bottles manufactured are principally 75 c. l. bottles, that is to say containing a pint and a half, but the firm also produces a fair quantity of quart or litre bottles weighing 850 gms. and some soda water bottles weighing 500 gms. Attempts were made to manufacture glass insulators and pressed ware articles but although these were made the cost of manufacture was found to be too high to permit of a profitable sale.

COSTING. A system of cost is employed by which the cost of the bottles is checked from time to time, and certain types of ware are not now made, as being unprofitable in view of the very limited demand. Costing is extremely necessary out here for this very reason. A difficulty in costing here is the necessity for keeping accounts in two currencies, francs and Mexican dollars—a system of accounting much favored by French firms operating in the French colonies. The fluctuations of the franc afford interesting opportunities for speculation and there is sometimes a strong temptation to immobilize funds after a fall or rise in values.

SCIENTIFIC AND TECHNICAL CONTROL. Boiler flue and producer gases are constantly analysed and undoubtedly a saving in coal has been effected. A Hilger strain viewer is employed for the examination at definite periods of a pan of bottles from the lehr. The annealing is on the whole very good. Pyrometers ordered more than 12 months ago have at last arrived, and it is hoped to install them in order that a record can be kept of the temperature where control is most essential. It was not found either to be possible or advisable to install a work's laboratory, but certain field tests of the raw materials are used.

FUTURE PROSPECTS OF THE COMPANY. When the writer sailed for Haiphong in April, 1924, he took with him full plans and instructions for the erection of a new furnace which was to be equipped with Lynch machines and Rankin automatic glass feeders. Unforeseen difficulties obliged the company to abandon the project and to resell the machines purchased.

MARKETS. There is a fairly big market not merely for bottles but for latex cups, flasks, vials, lamp chimneys and window glass in the Far East, particularly in the Malay

ANNAMITES INSPECTING BOTTLES

TRANSPORTING BOTTLES FROM STOREHOUSE TO JUNK

States, Siam, Hongkong, the Philippine Islands and the China coast. A high quality of glassware is demanded and fair prices are obtained.

So far as Indo-China is concerned there is for all practical purposes one client—the Government. The Government controls the alcohol trade and it purchases the bottles by contract, the capsules by contract, the alcohol by contract, and lets out by contract the bottling of the alcohol, and its transport to the retailers, who have to sell by contract at a fixed price. The government is therefore able to calculate for six to eight months ahead the amount of the profit it is going to make, while avoiding the actual troubles attending the carrying out of any of the work. The bottles supplied to the government have to comply with many specifications and for each delivery of bottles a commission of inspection is appointed consisting of three or more government officials, who examine the bottles. Sampling is done by taking one bottle at random in every thousand, and on the bottles sampled each dimension is verified, the weight and capacity are verified and the bursting pressure is tested by means of a hydraulic pump. The bottles have to withstand 150 pounds per square inch. Very seldom are bottles broken at this pressure, and when in a recent test it was requested that bottles should be raised to a bursting pressure, 5 were burst at between 30 and 40 atmospheres (450 to 600 lb. per square inch). As the bottles were only to contain non-effervescent rice alcohol the necessity for this test is not obvious. After the bottles have been officially accepted by the commission they are examined for defects by native women inspectrices, and this examination may in certain cases be unnecessarily severe. Attempts are often made to impose on the glass manufacturer by exchanging bottles which have been broken in the course of filling for new bottles on the pretense that such bottles have been broken or damaged in transport. The manufacturer is only paid for the net amount of bottles actually taken into stock at the government warehouses. A delivery of 160,000 bottles may take up to 15 days to effect and entails a big expenditure of time and patience. That the bottles are very strong is borne out by the fact that in bottling 30 million litres of alcohol per annum only 2 million new bottles are required though the bottles when full are sent far into the interior on springless carts over half obliterated tracks. This 2 million covers all bottles broken in transit and not returned and all losses during filling, etc., and the government anticipate from their returns that even this figure will be considerably reduced. It is rather curious that the government is obliged to give more to the native who returns a bottle to one of its agents than it pays the manufacturer for new bottles delivered to its own warehouses.

Local orders apart from the government are not very important and the local distilleries, breweries and soda-water factories as well as wine merchants, etc., do not together consume more than 500,000 new bottles per annum. Many bottles enter the colony already filled, particularly beer bottles and these bottles are exchanged, sold and used over again. One local brewer uses nothing but the second-hand bottles of a well known Japanese brewery for which he pays from $4 to $5 Mex. per 100.

In conclusion a few words might be said about the attitude to foreign enterprise in Indo-China. In contracts with the government insistence is usually laid upon the fact that the capital and management of their suppliers must be French. This can always be got around by forming a small nominal French company to run the concern and having a Frenchman to sign papers, and this has been done in the case of most foreign enterprises operating in Indo-China apart from the British banking companies. Various restrictions as to trading are placed upon foreigners principally in regard to the purchase and tenure of land. On the whole there is an impression that the foreigner of British and American extraction is courteously tolerated but not welcomed.

EDITORIAL NOTE: Donald Robertson, the author of the above article, who is a graduate of the School of Glass Technology, Sheffield University, England, is now in the Philippine Islands investigating the situation there with a view to interesting some responsible manufacturer in the possibility of establishing a factory or selling glassware in that territory. He states that the consumption of beer bottles in Manila and Cebu approaches 6,000,000 per annum. A firm in Hongkong annually consumes 1,500,000 soda water bottles, while soda water and boor bottles are required for Saigon, Singapore, Penang, Bangkok and Sourabaya to the extent of 3,000,000 bottles. Should a factory be able to produce glass latex cups at a price to compete with the porcelain cup, about 40,000,000 would be required.

Causes of Crizzles and Skin-Wrinkles of Pressed Glass*

Explanation of Defects and Their Prevention

By E. Zschimmer, K. Hesse and K. Meures†

Pressed glass often shows three kinds of surface defects, namely crizzles, skin-wrinkles—which when present in large quantities can cause the surface to become dull—and mold marks, which are the impression on the glass surface of ridges and scratches occurring in the molds. Since the latter are caused entirely by neglect of the molds they can be removed easily when care is taken to keep the surface always perfectly polished. It is remarkable that even the finest scratches on the surface of the mold are reproduced in every detail on the surface of the pressed glass. The glass surface is a perfect reproduction in relief of the lines and the faintest scratches occurring on the surface of the molds.

FIG. 1. GLASS GOB WITH TOUGH SKIN.

FIG. 2. GATHER WITH TWO SKINS.

Crizzles and wrinkles, however, are a different matter. They are constant and very difficult troubles incident to the glass pressing process and in our opinion cannot be entirely avoided even with the greatest care since they are caused by the nature of the glass and the material of the mold. They are partly also due to the shape of the pressed article. In this investigation it has been tried to explain the causes of these two glass defects. During this work it became apparent that the crizzles can be ascribed principally, if not entirely to wrong practices during pressing. This trouble can be disposed of in a few words and our attention can then be given to the main object of our investigation, the causes of skin-wrinkles and the possibilities of their removal.

The Behavior of Glass During Working

General speaking, glass, when taken at a high temperature from a pot or a tank is considered a liquid and only the viscosity and the surface tension of the liquid mass is considered to explain the physical working of glass by hand or by machinery. This conception however is technically insufficient and is not suited to explain the phenomena which show themselves as defects during the working of the glass. This does not only apply to pressed glass but to every kind of glass working, for instance the rolling of plate glass, the drawing of sheet glass from the molten mass, the drawing of glass tubing and to all sorts of glass blowing, whether by hand or by machinery. In pressed glass the conditions are simpler than in other kinds of glass working. This may become apparent from the following.

Let us consider a free falling gather of glass, just from the furnace, for instance a gob of glass falling from a feeder in a press mold of one of the well-known American systems. This gob cannot be considered as a completely liquid body but it must be imagined that in cold air it obtains instantly a tough skin (Fig. 1). This skin of the glass gather can be compared with a leather bag in which the liquid glass is held with its original viscosity. It is not therefore a homogeneous body, such as a drop of water. A gob of glass must be considered as consisting of two objects: a bag and the enclosed liquid, having the original viscosity of glass in the tank or pot. Strictly speaking this skin must be considered as being composed of a large number of skins, the toughness of which decreases towards the inside of the gather. But for all practical purposes and to explain the processes of glass working the original conception is sufficient and will be used in the following.

To complete the conception, a picture (Fig. 2) is given of a gather such as a glass maker forms on the end of his blow pipe. Here we have evidently not two but three bodies, an outside bag, an inside one, less tough, and between the two a liquid mass. While glass blowing usually is compared with the blowing of soap bubbles (ideal liquid bubble) the conception evidently must be changed in order to explain the phenomena of glass blowing. This applies also to a sheet drawn from molten glass (Fig. 3) or a sheet produced by the coming together of two layers of glass from above (Fig. 4). Here again are present three bodies which move in space, which are intimately connected and which exert influence on one another. Finally mention should be made of a tube (Fig. 5). This can be conceived to exist of a combination of two tubes. The inner one being softer than the outer one. The space between them is filled with the molten liquid glass. Phenomena which occur especially in the drawing of tubes by machinery can be explained without difficulty by means of this simple conception.

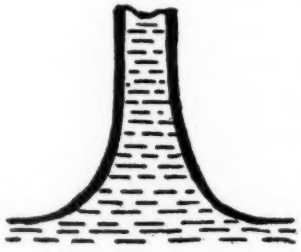


FIG. 3. SKIN OF A SHEET DRAWN FROM MOLTEN GLASS.

FIG. 4. SKIN OF A SHEET DRAWN FROM ABOVE.

Sprechsaal 58, 185-187. Translated for THE GLASS INDUSTRY.

†Contribution from the Glass Research Laboratory of the Technological Institute of the University of Karlsruhe.

Formation of Crizzles

When we consider pressed glass, the reason why crizzles occur is now at once apparent. In Fig. 6 the side wall of a pressed dish is shown having a bundle of crizzles running parallel to the edge. The direction of crizzles in general depends on the shape of the glass surface on which they occur. In a pressed square glass object there are usually two systems of crizzles, namely those parallel to the upper edge and those running perpendicular to this edge. Sometimes it happens that both kinds occur at the same time so that the crizzles cross one another at right angles. Flat glass dishes for instance and covers of preserve jars often show at the edges crizzles similar to those shown in Fig. 6. Be-

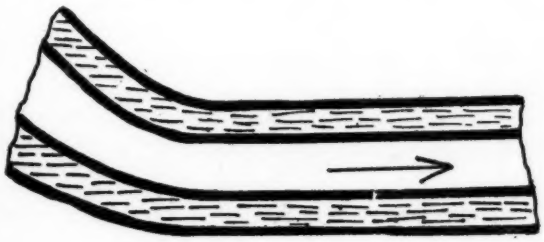


FIG. 5. THE TWO SKINS OF A GLASS TUBE.

sides these, in a circular bottom a system of concentric rings occur, crossed by crizzles running in the direction of the radius.

If a glass is used having a small working range, that is, a glass whose viscosity increases very rapidly within a short temperature range, for instance a heavy alkali-free barium glass of Schott, it can be observed that the tough skin formed on exposure to air breaks like an eggshell as soon as the massive lump of this glass is pressed. It can even be observed that the molten mass enclosed by the tough skin runs through the cracks similarly to the juicy meat of an over ripe plum whose skin is cracked open by pressure. This explanation of the cause of crizzles in pressed glass forces itself upon every one observing this phenomenon. What is seen at the moment of the formation of crizzles during pressing is due to the sudden change in the relation between dimensions of the surface of the skin and the size of the volume which it surrounds.

As is well known, the surface of a number of objects having the same volume is variable according to the shape of the object. If a number of glass gathers are observed derived from the same melt, having the same weight it will be found that their surfaces have a different size depending on the shape in which they have been pressed. If the bag shaped gather, represented in Fig. 1, is considered it is evident that if it is pressed in the form of a plate it is extended largely in its width and the skin therefore must of necessity be torn unless the nature of the glass and the temperature conditions during pressing are such as to prevent the formation of a very tough, brittle and fragile skin during the change in form. This indicates that when pressing glassware it is important to give attention to the shape assumed by the gather of glass before pressing and also to the change in form which the glass must take through the pressing operation. It is evident that the ball-shaped gather is in the majority of cases the most unfavorable. The realization of this fact is one of the most important features of the American feeder system. It should be tried to give to the glass gather at once the proper form such as the glass blower does by moving the gather in such a way that it assumes approximately the shape of the object to be made. Nothing is neglected to a greater extent during the pressing of glass by hand than this very important feature. It is only necessary to observe the shape of the punty in the different pressed glass factories to notice how little thought is given to the shape of the gob to be formed at the end. Strictly speaking, to every kind of pressed article belongs a punty with a head of a distinct shape, for on this shape depends the form of the glass gather. In addition the gatherer must in a certain sense be a skilled glass maker in order to understand how to give the proper shape to the gob of glass hanging on the end of the punty by means of skillful movements as it is done automatically in the feeders of the American pressed glass machines. Instead of that, pressed glass factories often employ totally unskilled labor. The construction of the mold must be in accordance with the principle that as little change as possible must be made in the shape of the bag

FIG. 6. CRIZZLES IN THE SIDE WALL OF A DISH.

filled with liquid glass. Just as important as the shape of the gather are the proper dimensions of the mold. If the shape of the gather does not resemble that of the object to be pressed it is advisable to change the form of the pressed object in such a way as to prevent excessive tearing of the tough skin of the gob during the time that the molten glass is pressed into the shape of the mold by the force of the plunger.

As stated before the inclination to form crizzles depends on the kind of glass with reference to its chemical composition, and on the temperature conditions during the melting process. Since the composition of the glass during the formation of crizzles has in general the same influence as during the formation of wrinkles further reference to this factor will be made later. With regard to the temperature the same conditions prevail for crizzles as for wrinkles. It should only be noted that one of the most frequent causes of the

formation of crizzles during pressing must be laid to the use of a cold mold. Especially those parts of the mold which must be laid aside after pressing each object, namely the cover and ring, cause the formation of crizzles since they become too cool. These parts should be continually reheated on a hot plate for it is clear that the cold metal when touching the skin of the gob will absorb heat and thereby render it so hard and brittle that an increase in surface will tear the skin.

Formation of Wrinkles (Waves), Dulling of Surface

When an apple dries up, the skin shows wrinkles. The formation of these wrinkles is simply due to the fact that the original surface of the inside ball, formed by the juicy meat of the apple contracts evenly during the drying process, similarly to the shrinking of a rubber balloon which has begun to lose its gas. However, the skin of an apple—since it cannot become smaller through evaporation—must keep its original surface. Yet through its connection with the inner part it is bound to stay with it. In short the original skin is forced to cover a body of smaller content which is only possible through the formation of regular or irregular wrinkles.

These considerations can be represented mathematically. In Fig. 7 two concentric balls are drawn of which the larger one has a volume V and the small one a volume v. A body having a volume v has the smallest possible surface if it has the shape of a ball. If without changing its volume it must fill the larger surface covering the ball of the volume V it must lose its ball shape and assume a form in which the relation of the surface to the volume is larger than in the ball shape. Geometrically considered there are unlimited

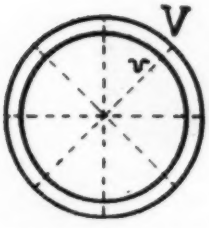


FIG. 7. EXPLANATION OF THE WRINKLES OF A GLASS BALL.

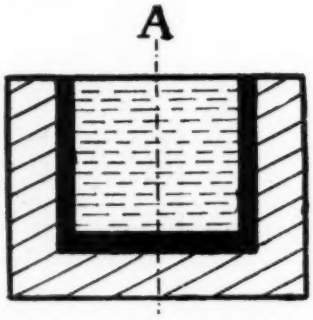


FIG. 8. SKIN OF A GLASS AFTER FILLING A CYLINDRICAL MOLD.

possibilities to fill this requirement; one of these is the wrinkled ball as represented by the skin of the apple.

Now imagine instead of the large ball V in Fig. 7 a glass gather with a tough skin as represented in Fig. 1. What will happen if this gather cools to such an extent that the bag acquires considerable toughness for instance through the blowing of cold air while the liquid mass in the inside contracts slowly? Evidently the same as in the case of the drying apple, the surface forms wrinkles. The same will happen if another shape is given to a mass of molten glass. For instance if liquid glass is poured into a cold cylindrical mold of metal a tough skin will form at once on the walls as represented in Fig. 8 and even to a much stronger degree than would be the case if a free surface is exposed to air. What happens during the solidification of this cylindrical mass is evident when it is imagined that from the bottom of the glass cylinder in Fig. 8 a slice is cut and its behavior observed during the process of solidification. A-B in Fig. 9 represents a bar of liquid glass having a tough skin at the bottom. If the liquid bar would solidify without the skin it would simply contract from the length A-B to the length a-b. However, the skin, which has much less power to contract and which may be imagined to be zero, will retain its original length at the solidification temperature. Through its connection with the liquid bar to which it is attached it is forced to assume the shorter dimension a-b. Since its surface cannot be diminshed materially it must become folded as shown in Fig. 9.

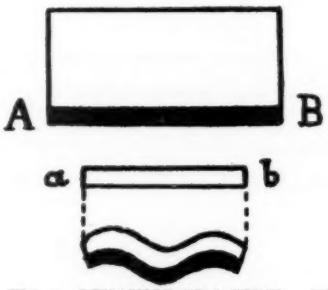


FIG. 9. BEHAVIOR OF A STRIP OF THE BOTTOM OF A GLASS CYLINDER.

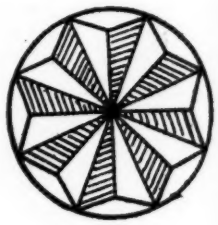


FIG. 10. THE FOLDING OF A FILTER.

If the surface of a cylindrical bottom as in Fig. 8 is represented, the change can be explained in Fig. 7. V represents the outline of the original liquid glass cylinder inside of the tough cylindrical bag, v is the shape which the bottom of the liquid glass cylinder would assume if it could shrink without the tough skin. Let it now be assumed that the whole surface V be cut up in thin sections along the diameter (dotted lines in Fig. 7). Everyone of these radial sections of the tough skin at the bottom of the surface V will take the wrinkled form of Fig. 9. The total surface of the cylindrical bottom will then appear like the surface of a circular pond into the center of which a stone has been thrown. A system of concentric circular waves will be formed. In this reasoning it is assumed that the liquid glass cylinder in Fig. 8 would shrink during the solidification process in such a manner that its bottom surface remains flat. This, however, does not always need to be the case. If the liquid glass cylinder contracts quicker in the direction of the axis A (Fig. 8) than in the direction of the radius, the surface of the bottom will be drawn upward in the shape of a funnel. In this case the skin will not assume the simple shape as represented in Fig. 7. Besides the ring-shaped wrinkles a second system of folds will occur. This can be represented as follows: A circular sheet of paper, for instance a filter, is pressed with a conical funnel. This is only possible if the surface of the paper is folded as indicated in Fig. 10, in which the number of folds may vary. In such a case it will be observed that the tough skin of the bottom of the cylinder in Fig. 8 is folded in the two systems which cross one another.

(*To be continued*)

Raw Materials of the Glass Industry

III. Salt Cake and Soda Ash. Part 1.

By J. B. Krak, Technical Editor

Practically every variety of glass contains an alkali base, either sodium or potassium, the latter being used in the manufacture of lead flint glass. By far the largest proportion of glass made at the present time, window and plate glass, bottles and jars, domestic glassware and illuminating ware contains sodium oxide. This substance can be introduced into the glass batch in two ways, namely, as salt cake or as soda ash.

There are other materials used in glass making that contain sodium oxide, namely nitrate of soda, borax, cryolite and feldspar. These substances are used to produce certain definite results: nitrate of soda to obtain oxidizing conditions, borax to impart valuable properties to the glass and to facilitate fusion, cryolite to give opacity, feldspar to introduce alumina into the glass. The amounts of sodium oxide thus added to the batch should be taken into account when the total quantity of sodium oxide desired in the glass is being considered.

The most abundant and cheapest form in which sodium occurs is as common salt, sodium chloride (NaCl). It is from this salt that salt cake and soda ash are produced. Unfortunately it is impossible to make glass from common salt. Sand and salt do not react to form sodium silicate except in the presence of steam and then only on a very limited scale. Most of the salt is volatilized before any reaction with the sand can take place. In order to obtain a reaction the salt must first be converted into sodium sulphate or salt cake or into sodium carbonate or soda ash.

The glasses of antiquity were made with natural soda, called *nitron* by the ancient Greeks, which name was changed to *nitrum* by the Romans. This name was also given to nitrate of soda. It was not until many centuries later that it was discovered that one name covered two substances of a different composition. Natural soda was obtained from lakes occurring in dry regions on the shores of the Eastern part of the Mediterranean, and also from the ashes of sea plants. In later centuries glass works were located near the large forests in order to obtain an abundant supply of fuel. Wood ashes, containing chiefly carbonate of potash became the main source of supply of alkali. When wood was no longer available and the use of coal became more general the glass industry again turned to sodium salts.

Manufacture of Salt Cake

At the present time most of the salt cake produced is obtained as a by-product of the manufacture of hydrochloric and nitric acids. In the Leblanc process, common salt and sulphuric acid are heated in a salt cake furnace consisting of two parts (see next page). They are first put into a circular pan and the mixture is moderately heated by a fire on the grate situated below the pan. The first reaction takes place at a comparatively low heat, the hydrochloric acid vapors escape and are absorbed. The following reaction takes place:

$$\underset{\text{Salt}}{NaCl} + \underset{\substack{\text{Sulphuric}\\\text{acid}}}{H_2SO_4} = \underset{\substack{\text{Sodium}\\\text{acid sulphate}}}{NaHSO_4} + \underset{\substack{\text{Hydrochloric}\\\text{acid}}}{HCl}$$

The fused mass of sodium acid sulphate and undecomposed salt is then transferred to the reverberatory hearth where it is exposed to a high temperature. This completes the second stage of the reaction:

$$\underset{\substack{\text{Sodium acid}\\\text{sulphate}}}{NaHSO_4} + \underset{\text{Salt}}{NaCl} = \underset{\text{Salt cake}}{Na_2SO_4} + \underset{\substack{\text{Hydrochloric}\\\text{acid}}}{HCl}$$

Nitric acid is made by treating sodium nitrate with sulphuric acid in cast iron retorts. The product remaining is called nitre cake and consists mainly of sodium acid sulphate. Roasting with common salt converts it into salt cake.

The purest kind of salt cake is obtained by the Hargreaves process. In this process damp salt is pressed into blocks and heated, leaving the blocks porous. They are then charged into vertical cast iron retorts, a number of which are connected in series. They are heated to about 500° Centigrade. Sulphur dioxide, steam and air are made to pass through the retorts in succession which slowly transforms the salt into salt cake. A cylinder containing 40 tons of material requires from two to three weeks continuous action to effect complete conversion. When the sulphur dioxide ceases to be absorbed in a cylinder, it is cut out of the series, the salt cake removed, a new charge of salt blocks introduced and the cylinder made the final one of the series so that the newly charged salt is exposed to the most nearly exhaused sulphur dioxide gas. The following reaction takes place:

$$\underset{\text{Salt}}{4\,NaCl} + \underset{\substack{\text{Sulphur}\\\text{dioxide}}}{2\,SO_2} + \underset{\text{Steam}}{2\,H_2O} + \underset{\substack{\text{Oxygen}\\\text{(from air)}}}{O_2} = \underset{\text{Salt cake}}{2\,Na_2SO_4} + \underset{\substack{\text{Hydrochloric}\\\text{acid}}}{4\,HCl}$$

The "Societe des Manufactures des Glaces et Produits Chimiques, St. Gobain" the well known French glass concern operates a Hargreaves salt cake works at Chauny (Aisne) to supply its need for a high grade iron free salt cake.

The average salt cake does not contain more than 95 or 96 per cent sodium sulphate. The impurities are common salt, "free acid" (which is sodium acid sulphate) calcium and magnesium sulphate, moisture and insoluble residue. Salt cake on exposure has a tendency to attract moisture and become hard and lumpy. Hargreaves salt cake contains about 98 per cent sodium sulphate. Salt cake has not been used in the glass industry as long as soda ash. It is more difficult to make glass with salt cake than with soda ash. The material by itself, like common salt, will not flux on heating with sand and lime. It is not volatile at the furnace temperature but melts and floats on top of the other batch ingredients, unless it is first reduced and thus made available for chemical action. This is done by adding carbon in some form, usually as coke, charcoal, or anthracite, which enables the silica to decompose the sulphate. The reaction may be illustrated by the following equation:

$$\underset{\text{Salt cake}}{2Na_2SO_4} + \underset{\text{Carbon}}{C} = \underset{\substack{\text{Sodium}\\\text{sulphite}}}{2Na_2SO_3} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2}$$

The carbon dioxide is a gas and escapes with the waste gases.

The sodium sulphite formed reacts with the sand to form sodium silicate as follows:

$$\underset{\text{Sodium sulphite}}{Na_2SO_3} + \underset{\text{Sand}}{SiO_2} = \underset{\text{Sodium silicate}}{Na_2SiO_3} + \underset{\text{Sulphur dioxide}}{SO_2}$$

The sulphur dioxide escapes as a gas and sodium silicate formed reacts with the other constituents of the batch, lime and the excess of sand, to form glass.

In the above reaction 12 parts by weight of carbon are required to reduce 142 parts of sodium sulphate or 8½ per cent. In practice it has been found that 5 per cent carbon is sufficient. It is essential to carefully determine the amount of carbon required. Unreduced salt cake may float on the surface of the molten glass and form "salt" or "gall." The reducing atmosphere of a tank tends to decompose the gall since the furnace gases contain free carbon and compounds containing carbon, which act on the gall, floating on the surface. Addition of powdered charcoal to a pool of gall sometimes has the effect to dissipate the salt cake. An excess of carbon should be avoided since it may cause the glass to get an amber color.

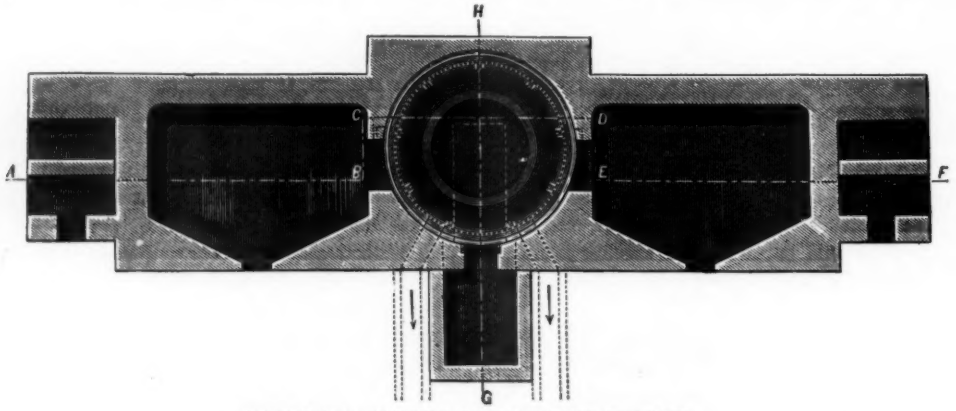
The use of salt cake is limited to those glasses where good color is not essential. It cannot be used in the manufacture of glasses containing lead as in crystal and semi-crystal ware, since reducing conditions necessary for the successul use of salt cake would cause a reduction to metallic lead. Lead glasses should be made in an oxidizing atmosphere, using red lead which produces free oxygen and sodium nitrate. In the presence of these substances salt cake would not be reduced but would float on top of the melt as gall.

Salt cake, except that made by the Hargreaves process, always contains enough iron to impart a distinct color to the glass. This is not objectionable in window and bottle glass, but is undesirable in heavy plate glass. Many glass makers prefer to use soda ash and add only a small percentage of salt cake to prevent the formation of scum which an all-soda ash batch is likely to produce. A very successful formula for window glass is the 26, 6, 36 batch, (26 lbs. of soda ash, 6 lbs. of salt cake, 36 lbs. of limestone) which is well adapted to machine made cylinder glass.

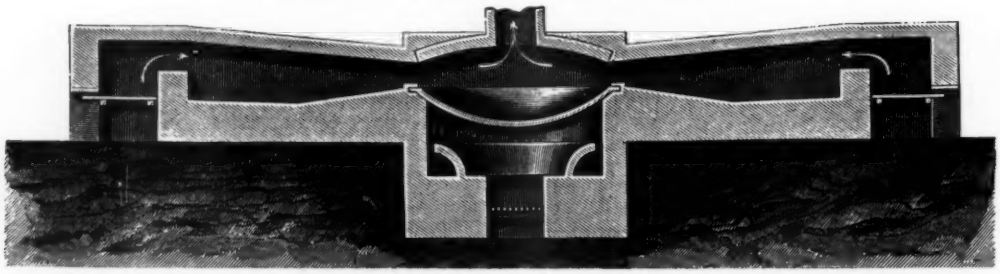
Salt Cake or Soda Ash

There is still considerable difference of opinion regarding the relative advantages of soda ash and salt cake. Pound for pound salt cake is cheaper than soda ash. But in estimating the cost it should be remembered that is the sodium oxide that is bought. Salt cake is composed of 43.7 per cent sodium oxide and 56.3 per cent sulphur trioxide. Soda ash, on the other hand, contains 58.5 per cent sodium oxide and 41.5 per cent carbon dioxide. To obtain the same amount of sodium oxide, 0.75 parts of soda ash is equivalent to 1 part of salt cake. If it is further considered that salt cake is usually only 95-96 per cent pure whereas soda ash seldom runs below 99 per cent, it will be recognized that the difference in price is largely illusory.

Soda ash has certain advantages over salt cake which has resulted in a gradual replacement of salt cake by soda ash, although as stated before the best results are obtained by using a mixture of both in certain proportions. The output of finished glass per 24 hours for the same tank is greater when soda ash is used. This can be explained when it is considered that the reaction between soda ash, sand and limestone commences at a lower temperature than when salt cake is present. Also less gas has to be expelled in the case of soda ash. A salt cake batch is more corrosive than a soda ash batch. Repairs are less frequent and the life of the tank is prolonged when soda ash is used. The color of the glass



HORIZONTAL SECTION OF SALT CAKE FURNACE



VERTICAL SECTION OF SALT CAKE FURNACE ON LINE A-F.

is better and less decolorizer is needed. The waste gases contain harmless and odorless carbon dioxide whereas sulphur dioxide has a disagreeable odor and is distinctly harmful to plant and animal life. There are numerous experienced glass makers however who claim that salt cake glass is harder and has a greater strength than soda ash glass.

Action of Sodium Oxide in Glass

Sodium oxide combines with sand to form sodium silicate. This substance is soluble in water and in order to obtain a stable glass one or more stabilizing basic oxides are necessary, usually lime, magnesia, barium oxide, lead oxide, zinc oxide, and others. A glass analyzing about 71 per cent silica, 14 per cent lime, 14 per cent sodium oxide, 1 per cent alumina is well balanced and withstands weathering to a marked degree. Increase of sodium oxide at the expense of the lime increases the viscosity range and allows the glass to be worked over a longer range of temperature, it makes glass "easier to work." For this reason some of the machine made glasses run considerably lower in lime (7-8%) and proportionately higher in sodium oxide (16-18%); this applies to both window and bottle glass. An important advantage, besides longer range of workability is the decreased rate of cooling due to smaller heat conductivity. The annealing temperature of high soda glass is lower than one of the "standard" composition.

A disadvantage of low lime, high soda glasses is the decreased durability especially where the amount of sodium oxide surpasses 18 per cent. In window glass this shows itself in premature weathering. In bottle glass it causes solution of sodium silicate in the liquid held in the container and deposition of flocculent silica as a sediment. This renders a beverage unfit for consumption. High sodium oxide is responsible for the decay of glass ware stored in a damp warm store room, or when packed in damp hay. The glass surface absorbs water, becomes dull and after some time begins to peel off in thin layers, not unlike fish scales. When water is added to a glass container showing this trouble, and a few drops of phenolphthalein are added, a red color shows the presence of free alkali.

There is of course always a temptation to add more soda or salt cake to a batch than what has proven to be good practice. It should be remembered that over and above a certain percentage any increased output obtained is at the expense of quality and durability of the product.

The Action of Barium in Glass*

Barium carbonate melts very easily and in this respect, among the alkaline earths, it resembles the alkali carbonates, soda ash and potash, so that it may be considered as a flux. Barium carbonate differs in this regard from carbonate of lime, which is considered frequently, but incorrectly, as a flux. However, barytes cannot replace soda and potash entirely, but by the introduction of much barytes some alkali can be saved, since the fusibility of glass increases with the amount of barium present. It cannot be done for the sake of economy, since barytes has become too expensive due to its increasing use in other lines of industry. The cost of barytes is $55 a ton against soda ash $26-$29 a ton. Barytes is used only when certain definite properties of the glass are desired. Barium oxide is much less soluble in water or acids than sodium oxide. Barium oxide is only 1/28th as soluble as sodium oxide, but is 23 times as soluble as lime. Therefore by replacing sodium oxide by barium oxide the solubility is decreased and thereby the durability increased. For this reason barytes is used in the manufacture of the better grade of table ware, to replace part of the soda. Its principal advantage over limestone lies in the fact that the melting is easier even if large quantities are used and that the fining is accomplished quicker. Its principal use is, however, not to replace lime but to replace lead, for barium acts in glass similar to lead, giving it not only a high specific gravity, but above all a fine polish, obtainable only with lead or bismuth, and to a much lesser degree with boric acid. This explains the ever increasing use of barium carbonates during the past 40 years especially in the manufacture of semi-crystal, fine and ordinary cut and pressed glassware, of electric light bulbs, and illuminating ware. The coefficient of expansion of barium oxide is the same as that of lead oxide ($a = 3.0^{10.7}$), the electric conductivity is almost the same. Barium oxide has further the property to make the glass melt very easily. For this reason it is used in the manufacture of pressed glass.

The optical properties of barium oxide, which are very much like those of lead oxide, especially with regard to the refractive power, caused its application to the manufacture of optical glasses, especially photographic objectives and lenses for telescopes. This application is due especially to the work of Schott and associates, Jena. Very good glasses have been made in Jena having a barium oxide content of 50 per cent, which exemplify especially the favorable qualities of barium oxide in glass. It is of special importance that barium renders glass harder than lead. Lead glasses with 50 per cent PbO are so soft that they have very little resistance against wear and tear due to sand, dust, scratching, etc. In this respect heavy barium crown glasses for the outside lenses of optical apparatus are much better than heavy flint glasses. Unfortunately glasses with high barium content (40 per cent and more) turn yellow just as easily as those containing lead. They further have the disadvantage that, contrary to the tendency of lead glasses, they devitrify easily. Another great advantage of barium glasses over lead glasses is the fact that they are totally proof against oxidizing or reducing flames, for which reason lead-free barium glasses, high in barium oxide can be melted in open pots or in tanks, without danger of being reduced, whereas the melting of glasses with 40 per cent lead oxide in open pots is very risky and melting in a tank furnace, even for glasses much lower in lead, is entirely impossible. Another advantage of barium glasses over lead glasses is that they can be fire-polished without trouble. Artificial barium carbonate is much to be preferred to the natural witherite. It costs only about one-fifth of the price of red lead. One hundred parts of red lead give 97 parts of lead oxide to the glass, whereas 100 parts of barium carbonate give only 76 parts of barium oxide.

*_Keramische Rundschau_. Vol. 33, No. 12, p. 192. Translated for THE GLASS INDUSTRY.

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The Human Factor

Many of those engaged in manufacturing agree that among the trials and difficulties which are inseparably connected with the production of commodities, the most uncertain element to deal with is the human factor. Obstacles of a mechanical nature usually can be overcome if a process is at all capable of successful development. Problems of a chemical origin in most cases are solved by experiment and study. Questions of organization, finance and management can be worked out to a satisfactory solution. But the human factor is always present. It is the one that gives the greatest uncertainty and is the least dependable. Little wonder it is that the tendency of modern industry is towards its elimination wherever possible.

Machinery is constantly being developed to a higher state of effectiveness. Chemical processes are being better understood and controlled with greater precision. Methods of management are being worked out to a point where enthusiasts begin to talk of it as a "science." But the human factor is as uncertain as ever, and in some respects not as dependable as in the past.

It is recommendable that the worker of to-day shall have many interests besides his occupation—his car, his radio, the moving pictures and the many other things of modern life which make existence worth while. But all these diversions, commendable as they are, cost money and it has come to pass that in the eyes of many money has become the sole object of work. The satisfaction of doing a piece of work well, which was the pride of the craftsman of the past is being pushed more and more into the background by the desire to "get the money" regardless of whether it has been earned or otherwise.

It is especially the small manufacturer, he who comes in daily and intimate contact with workers, who realizes this state of affairs. Not that conditions are better in large corporations, but their size makes one lose sight of the existence of this tendency. The small manufacturer also stands to lose more heavily than the larger one since one blunder causes comparatively greater harm when it occurs in a small establishment.

The remedy, if any there is, must be found in the re-education of the worker and by bringing home to the younger generation some of the truths practised by those who have made this country a great nation. There is no satisfaction like that which comes from the knowledge of doing work to the best of one's ability, from the pride of being a master craftsman in whatever line of work one may be engaged. It is the basis of all progress.

The Glass Institute Should Be Organized

The organization of the Clay Products Institute and the American Refractories Institute are indications that the value of co-operative research is being appreciated more and more by forward looking manufacturers. It is certain that the industries supporting these organizations will reap substantial benefits from their investment.

The opinion has been repeatedly advanced, with all the emphasis in our power, that the organization of an American Glass Research Association, or an American Glass Institute

would be the greatest good that could befall the industry.

Every glassmaker knows that the solution of only a few of the problems with which the glass industry is confronted would return many times whatever would be needed for the support of such an organization. It is believed that it is worth while to ascertain the feeling existing among glass makers with regard to this proposition. It is natural to look towards existing agencies for initiative in this matter and we venture the opinion that it is clearly up to the Glass Division of the American Ceramic Society to sound the sentiment of the glass world. If it is found that the majority favors such an organization the Glass Division should take steps leading towards its creation.

Technical Consultation Service

QUESTION 73. DECOLORIZER FOR GLASS. Will you kindly advise me what is the best thing to use to lighten or lessen the color in glass due to a large amount of iron in the sand, as for instance, one containing 0.4% Fe_2O_3 causing a blue-green deep color. Sometimes it runs to a half of one per cent. Selenium, nickel or cadmium do not help.

ANSWER. We are of the opinion that no amount of decolorizer known at the present time will neutralize the color due to the sand containing 0.4 to 0.5% Fe_2O_3. The only remedy which suggests itself is to obtain a purer sand. It would also be advisable to watch the composition of the limestone—J.B.K.

Advises Further Investigation of Use of Zirconia in Glass

To the Editor of THE GLASS INDUSTRY:

After reading in your May issue the results of the investigation conducted by Prof. Turner and his associates in the Department of Glass Technology at Sheffield concerning the use of zirconia in glass making, the writer is tempted to give herewith some data on the same subject. Too much credence, however, cannot be placed on this data, inasmuch as the exact sources of information have not been given, although it is stated that the investigation was conducted by the Royal Testing Laboratory at Berlin, Lichtenfeld, and was pursued under the direction and expense of Mr. Eduard Rietz of Sao Paulo, Brazil, now deceased.

The results as given in this data do not agree with those given out at Sheffield University with one exception. Both investigations have proven, when zirconia was substituted for silica, the resistance to alkaline solutions became very marked. The following table was given which shows not only a resistance to alkalies, but also to the various acids. It will be noted, however, that the exact nature of the glass subject to tests was not given.

WEIGHTS OF THE SAMPLES

Acids and Alkalies applied in tests	Before the test	After 2 weeks immersion	After 6 hrs. boiling in acid	After ¼ hr. in fused soda	Per cent of loss
Conc. muriatic	14.80	14.79	14.79		0.068
Conc. nitric	16.55	16.55	16.55		0.0000
Conc. sulphuric.....	14.09	14.08	14.08		0.068
Fused soda, red hot..	14.80	—	—	14.65	1.013

In direct contradiction to the results obtained at Sheffield, it was further shown that zirconia does render the glass less sensitive to sudden great changes in temperature (reduces thermal expansion) and increases effectively the resistance of glass against thermal shock. In addition, as noted in above table, a greater resistance to all acids and alkalies is shown.

A record of twelve compositions is also given, however, without any further comment other than noted. This record is herewith given in the table below:

Comments on the twelve glasses tabulated below are as follows:

Glass No. 1—A good tough glass, easily fusible, colorless, acid resisting, extremely hard when cold.

Glass No. 2—Glass is too brittle, still easier fusible, very hard when cold.

Glass No. 3—Easy fusing, clear and uncolored, quite liquid, flows easily.

Glass No. 4—Liable to get seedy, otherwise similar. Very liquid at 1520° C.

Glass No. 5—Easily fusible, clear, beautiful gloss.

Glass No. 6—Easily fusible, clear, beautiful gloss.

Glass No. 7—Softening at 1180° C., easily flowing at 1700° C. Very acid and alkali resisting.

Glass No. 8—Softens at 800° C. (1470° F.) flows at 1300° C. (2370° F.).

Glass No. 9—A good colorless tough glass, easily fusible.

Glass No. 10—Fuses easily.

Glass No. 11—Liquid at 1600° C., clear, slightly yellowish.

Glass No. 12—Gives clear, easily fusible glass.

It, therefore, appears that this subject was given some thought as early as the year 1914, the time at which these tests are reported to have been made. The writer is of the opinion, however, that zirconia, due to its physical and chemical properties, should merit further consideration and believes that the field of research in this connection is one which should not be overlooked, notwithstanding the results obtained at Sheffield.

It should also be noted that the composition of the so-called "Horak" glass, patented by Venzel Horak of Czechoslovakia, contains zirconia. It is claimed for this glass, that it resists sudden changes in temperature and upon breaking is not shattered in a large number of fragments.

The Vitro Manufacturing Company, THEO. LENCHNER.
Pittsburgh, Pa.

Number of tests	Sand or silica	Lime	Alumina	Lead oxide	Soda ash	Potash	Nitrate	Borax	Boric acid	Zinc oxide	Barium carbonate	Manganese dioxide	Zirconia
1	100	—	15	—	—	—	—	40	—	24	164	—	20
2	100	—	15	—	—	—	—	40	—	24	164	—	40
3	100	4.94	—	—	25.8	—	—	—	5.24	—	—	—	17.33
4	100	—	—	25	15	—	—	—	20	—	—	—	40N
5	100	—	—	—	20	—	—	30A	—	—	25	—	40
6	100	—	—	—	30	—	—	30A	—	—	25	2	40
7	100	7	—	—	30	20	—	—	—	—	—	0.76	10N
8	100	12.25	—	—	30.7	19.4	—	—	—	—	—	0.76	16.4N
9	100	8.9	3.3	16.7	—	33.4	3.3	16.7	—	11.1	—	—	11.1N
10	100	26	—	—	46	—	—	—	—	—	—	—	11
11	100	7	—	—	30	10	—	—	—	—	—	0.5	8
12	100	—	—	—	—	—	—	50	—	6	—	—	6

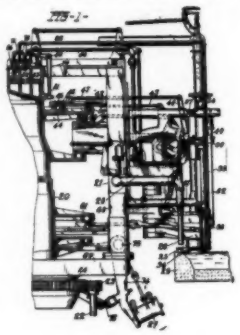
In Borax, A means anhydrous or free of water.
In Zircon, N means natural Brazilian dioxide containing 70 to 85% ZrO_2.

Recent Patents

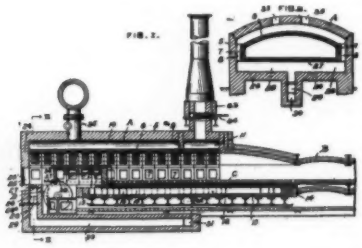
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

GLASS-FORMING MACHINE. 1,534,036. Apr. 21, 1925. Thomas Stenhouse, Washington, Pa., and Leonard D. Soubier, Toledo, O. Filed 9/29/22. Includes in a glass-forming machine, the combination of a mold, means to dip the mold into molten glass and charge it by suction, a cutter, means to move the cutter across the lower end of the mold and sever the glass, means to open the mold, and a burner comprising an annular series of openings arranged to direct an annular flame against the lower peripheral edge of the blank after the mold is opened. The invention is intended to prevent the formation of chill marks, scars, etc., due to chilling of glass when being severed.

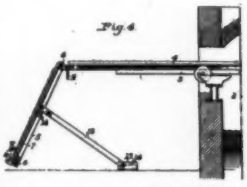


ANNEALING FURNACE AND LEHR. 1,533,298. Apr. 14, 1925. Walter O. Amsler, Pittsburgh, Pa. Filed 6/3/21. Includes an annealing furnace, the combination of an annealing chamber, a carrier for articles to be annealed consisting of an endless belt carried on a drive wheel, the wheel being arranged beneath and extending through an opening in the floor of and into the annealing chamber; and the side walls and roof of the annealing chamber overhanging the drive wheel, the belt of the carrier from its point of tangency with its drive wheel extending wholly within the annealing chamber, and a muffle chamber enveloping the walls of the annealing chamber and enveloping the overhanging portion of the roof and side walls of the annealing chamber.



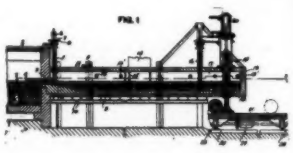
GLASS. 1,529,259. Mar. 10, 1925. Fred M. Locke and Fred J. Locke, Victor, N. Y. Filed 12/9/22. The inventor claims a glass batch containing silica, alumina, calcium fluoride, boric acid, and lead oxid, and capable of making a transparent glass having the quality of high electrical insulation under heat and having a co-efficient of expansion of less than .0000050.

TILTING TABLE FOR LEHRS. 1,537,498. May 12, 1925. Louis R. Schmertz and Laurence A. Gessner, Jeannette, Pa., assignors to Window Glass Machine Co. Filed 5/16/23. This invention relates to tilting tables for lehrs, particularly lehrs for handling sheet glass. It includes in a lehr, a pivoted receiving table and means spaced from the pivot for supporting the table, the means including a point of support movable with respect to the pivot point of the table and thereby operating to tilt the table.



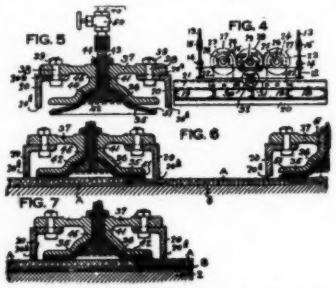
GLASS-TRANSFER APPARATUS. 1,529,584. Mar. 10, 1925. John H. Fox, Pittsburgh, Pa. Filed 3/27/24. The inventor claims in combination in a system for surfacing sheet glass, having a track with cars or tables on said track and means for moving the cars along the track, a platform for use in handling and laying the glass mounted on a track parallel to the track on which the cars are mounted, mechanical connections driven from said means which move the cars adapted to shift said platform forwardly with the cars at the same rate of speed as the cars, and a motor for giving the platform movements back and forth longitudinally of the track at a higher rate of speed.

APPARATUS FOR MAKING PLATE GLASS. 1,535,062. Apr. 21, 1925. Frank E. Trautman and Charles H. Christie, Butler, Pa. Filed 5/7/19. The invention comprises an apparatus for making flat glass, the combination of a melting furnace, a shallow runway of materially greater length than width communicating with the furnace, means independent of the furnace for controlling the temperature of the glass at the outer end of the runway, a receptacle adapted to receive glass from the outer end of the runway and having a discharge opening in its bottom, a casting table adapted to move beneath the opening, and means for forming the glass on the table into a sheet.



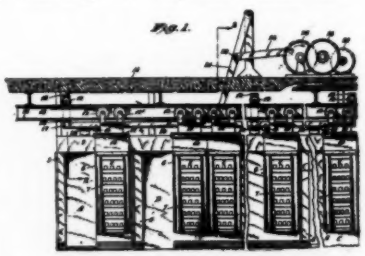
PROCESS OF MAKING PLATE GLASS. 1,535,061. Apr. 21, 1925. Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed 5/7/19. This invention relates to a method of casting molten glass that comprises flowing the glass through an outlet upon a casting table, advancing a casting table beneath the glass outlet, and regulating the amount of glass received on the table by controlling the speed at which the table advances.

METHOD OF LAYING PLATE GLASS. 1,535,063. Apr. 21, 1925. Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed 1/20/23. This invention relates to the manufacture of plate glass and other forms of flat glass. Its object is to provide improved apparatus for laying such glass on grinding or polishing tables, whereby an entire table of glass, including several sheets or pieces, may be laid in plaster simultaneously and with the upper surfaces of the sheets or pieces of glass at an even height, even though the individual sheets may not be of exactly the same thickness.



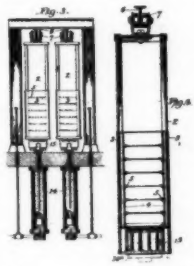
APPARATUS FOR LAYING PLATE GLASS. 1,535,064. Apr. 21, 1925. Frank E. Troutman and Charles H. Christie, Butler, Pa. Filed 1/20/23. The object of this invention is similar to that of Patent No. 1,535,063.

APPARATUS FOR ANNEALING GLASSWARE. 1,534,863. Apr. 21, 1925. George G. Oliver, Wheeling, W. Va., and Thomas Stenhouse, Washington, Pa., assignors to Hazel-Atlas Glass Co. Filed 1/31/23. This invention includes an apparatus for annealing glassware, an annealing lehr having inlet and discharge ends and an annealing chamber, swing doors at the end of the chamber, a series of containers for a plurality of trays of glassware arranged in tandem, a suspension for each container from an overhead trolley,



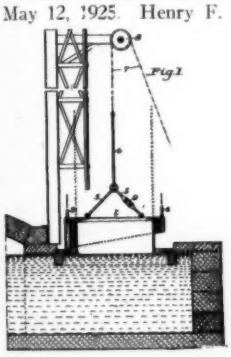
and a plurality of reciprocating means engaging and actuating each such suspension in the lehr and arranged to advance it successively through the doors, these means being operative on the forward stroke and inoperative on the return stroke, and the doors being opened successively by the movement of each container.

APPARATUS FOR TEMPERING GLASSWARE. 1,534,864. Apr. 21, 1925. George G. Oliver and Thomas Stenhouse, Washington, Pa., assignors to Hazel-Atlas Glass Co. Filed 12/19/19.



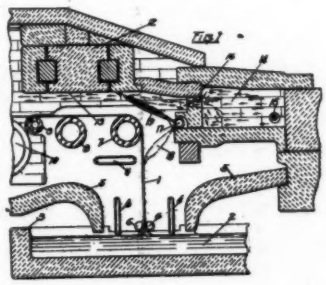
This invention relates to the annealing of glassware and consists in providing apparatus arranged for transferring the glass from the forming machine to the packing room while it is being tempered and cooled. It comprises an inner container and an outer container, the inner container having a closed top and bottom and a series of shelves having open sides, and an outer container having closed walls open at top and bottom, the inner container being adapted, when filled with ware, to rest in the lower portion of said outer container, the side walls of the outer container and the top and bottom of the inner container comprising a complete closure for excluding air during annealing.

COOLING HOLLOW GLASS ARTICLES DURING DRAWING. 1,537,462. May 12, 1925. Henry F. Clark, Oakmont, Pa., assignor to Window Glass Machine Co. Filed 6/8/21.

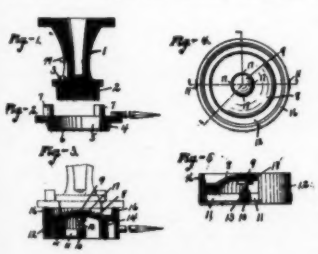


The invention relates to a method of drawing glass cylinders from a forehearth with apparatus having a cooler adapted to exert a stronger cooling influence on the tank side of the cylinder than on the breast wall side thereof, the step consisting in varying the relative cooling effect on the tank side and the breast wall side by adjusting the position of the cooler relative to the cylinder being drawn. The invention is designed to eliminate the cause of "thick and thin" glass in the drawn cylinders by regulating the temperatures at desired points.

DRAWING AND FLATTENING SHEET GLASS. 1,534,567. Apr. 21, 1925, Clyde W. Belden, Shreveport, La. Filed 9/5/22. Embodies in a sheet glass drawing apparatus, wherein the sheet is drawn vertically from a bath of molten glass and then bent into the horizontal plane, means for reheating the sheet comprising a member of heat radiating material under which the sheet moves in its horizontal run, and a heating means adapted to play against either the vertical run of the sheet or the radiating member.

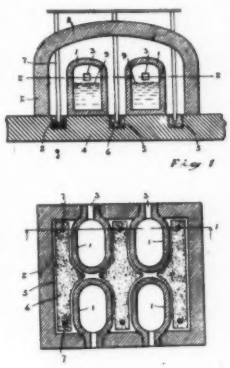


METHOD OF PRODUCING FINISHED SURFACES UPON GLASS. 1,534,671. Apr. 21, 1925. Harold J. Stead, Geneva, N. Y. Filed 8/31/22.



The invention includes a method of producing a bifocal lens blank comprising heating a glass material to a moldable temperature, bringing into contact with the heated glass material, a highly polished metallic mold section under pressure sufficient to produce at the central portion of the resultant blank an optical surface suitable for visual purposes without grinding, and simultaneously bringing into contact with the glass material another comparatively large mold section to form about the central portion an outer surface molded an approximate curvature, and elevated above the central optical surface, and then grinding and polishing said outer surface.

GLASS FURNACE. 1,529,480. Mar. 10, 1925. Allan Grauel, Oshawa, Ont., Can., assignor of 1/10th to Fred Chas. Hoar, Bowmanville, Ont., Can. Filed 1/20/23.



The invention relates to a glass furnace, the combination with a closed furnace wall and a bed therefor, of channels formed in the bed and extending across the furnace, glass pots supported on the bed between the channels having work openings extended through the furnace wall, a filling of granular carbon arranged in the channels, and electrodes arranged at the ends of the channels and bedded in the carbon. The electrodes form conductors for the electric current which flows through the carbon beds from end to end thereof and the current in passage heats the carbon to a high state of incandescence.

PLATE-GLASS-POLISHING MACHINE. 1,536,847. May 5, 1925. Herman S. Heichert, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/5/23. The invention relates to apparatus for polishing plate glass, the object being to provide an arrangement whereby the felt may be cleaned easily. It includes apparatus for polishing plate glass, a rotatable frame mounted for vertical movement, means for raising and lowering the frame, means for rotating the frame, a carrier for the glass mounted for movement transversely of frame, a plurality of vertical bearings pivotally mounted in frame so that they may be swung laterally, a plurality of polishing blocks having spindles mounted in bearings, releasable means for locking the bearings in vertical position, and releasable means for locking the bearings in position after they have been swung laterally, the frame being of such diameter that the runners project out past the side of carrier when the bearings are swung to their lateral positions.

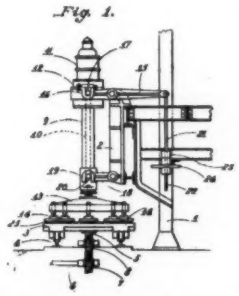
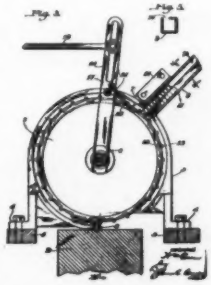


PLATE-GLASS-POLISHING APPARATUS. 1,536,917. May 5, 1925. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 6/5/23. This invention relates to apparatus for polishing plate glass, similar to Patent No. 1,536,847.

APPARATUS FOR FEEDING GLASS BLANKS. 1,536,918. May 5, 1925. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 5/13/24. The invention relates to apparatus for feeding glass blanks. It includes in combination with a tunnel heating chamber and a carrier mounted for movement through the chamber, a wheel mounted for rotation transversely of the carrier thereabove and provided around its periphery with spaced recesses for the blanks to be fed, an inclined blank carrying chute leading to the periphery of the wheel and adapted to feed the blanks therein into the recesses, a retaining flange extending around the wheel in opposition to the blanks to a point above the carrier, and means for giving the wheel an intermittent step by step movement.



TRAVELING FUNNEL GUIDE FOR GLASS-FORMING MACHINES. 1,531,561. Mar. 31, 1925. James W. Lynch, Anderson, Ind., assignor to Lynch Glass Machinery Co. Filed 4/11/24. This invention

consists of a traveling funnel guide for glass-forming machines having molds traveling in a cyclical path, a funnel and supporting means therefor movable in an independent path immediately above that of the molds for a feeding portion of the cyclical path, power driven members movable with the molds and adapted to engage successively with a co-operating part of the funnel supporting means during the feeding portion of the cycle, and fluid pressure operated means for returning the funnel supporting means to its starting position during intervening intervals between successive feeding movements of the molds.

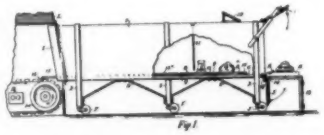
GLASS AND BATCH THEREFOR. 1,536,920. May 5, 1925. Joseph C. Parkinson, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 11/15/22. The invention relates to absorptive glass, and has for its object the provision of a glass adapted for use in spectacles which cuts off the passage of ultra violet rays and a portion of the violet rays which is highly transparent and has a yellow tint. The batch used in producing the glass is as follows:

	Parts by weight
Sand	930
Soda ash	250
Whiting	310
Potash	122
Borax glass	100
Cadmium sulfide	13
Sulphur	4

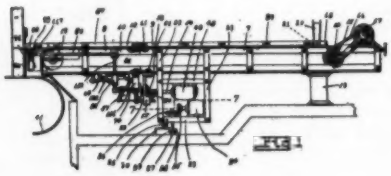
ABSORPTION GLASS AND METHOD OF MAKING IT. 1,536,919. May 5, 1925. Joseph C. Parkinson, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 11/15/22. The invention relates to glass for absorbing the ultra violet rays of light and has for its object the production of a glass which requires a small amount of chemicals and which is clear and colorless as opposed to the tinted glasses. The following batch formula may be used to produce a satisfactory glass:

	Pounds
Sand	1,000
Soda ash	423
Whiting	100
Cerium hydrate	43½
Salt	25
Arsenic or antimony	5
Salt cake	50
Coal	3

GLASS LEHR. 1,537,027. May 5, 1925. Marshall W. Gleason and Clarence G. Miller, Brooklyn, N. Y., assignor to Gleason-Tiebout Glass Co. Filed 11/24/24. The invention includes a removable attachment to glass lehrs composed of a body forming an elongated chamber, one end of which is adapted to connect with the mouth of a lehr, of parallel rails on the floor of the chamber, of interlocking pans traversing the rails and of means for moving the pans into and through the chamber.

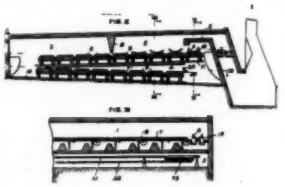


LEHR CONVEYOR MECHANISM. 1,537,277. May 12, 1925. Percy Q. Williams, Cincinnati, O. Filed 7/29/22. The invention includes the combination of a lehr, a lehr conveyor, a conveyor adapted to carry ware on its side and to deposit the ware onto the lehr conveyor exteriorly of the lehr, and means to intermittingly move ware over the lehr conveyor into the lehr, the intermittingly actuating means being adapted to be controlled by the ware.



TRAVELING FUNNEL GUIDE FOR GLASS-FORMING MACHINES. 1,531,560. Mar. 31, 1925. James W. Lynch, Anderson, Ind., assignor to Lynch Glass Machinery Co. Filed 4/11/24. This invention consists of a feeder for glass forming machines comprising molds moving in a curvilinear path, a runway passing below the feeder outlet, a funnel provided with an elongated hopper and a center spout mounted on the runway, the spout being disposed below the runway and above the curvilinear path, means for moving the funnel along the runway in time with successive molds, and means carried by the runway for tilting the funnel as it moves over the molds to swing the spout crosswise of the runway to follow the curvilinear path.

WINDOW-GLASS APPARATUS. 1,536,717. Apr. 28, 1925. James G. Cleveland and Harry L. Keller, Arnold, Pa. Filed 3/24/23. This invention includes in window glass flattening apparatus the combination of an intake chamber, a furnace chamber and a lehr chamber, the chambers being straight-walled and arranged in parallelism and the intake chamber and the lehr chamber overlapping the furnace chamber and communicating therewith through lateral openings, and the intake chamber and the lehr chamber being arranged vertically one above the other.



PROCESS AND APPARATUS FOR FORMING SHEET GLASS. 1,538,327. June 17, 1922. Holbert K. Hitchcock, Pittsburgh, Pa., assignor of one-half to Hitchcock Experiment Co. Filed 6/17/22. The invention relates to a process of forming sheet glass from a bath of molten glass which consists in extruding the glass through a hot slot and thereby imparting to it a shape similar to the finished sheet, subjecting the sheet immediately adjacent the slot to parallel traveling pressure on its opposite faces and for substantially its entire width and thereby imparting more accurate dimensions thereto, artificially cooling the traveling pressure means, and pulling the sheet from the traveling pressure means.

PLUNGER GATHERING OF GLASS. 1,537,962. June 24, 1921. Frank O'Neill, Toledo, O., assignor to O'Neill Engineering Co. Filed 6/24/21. The invention relates to a glass feeder plunger drive embodying a rock shaft having two pinions, a piston and cylinder actuator for one of the pinions, and a plunger stem driven from the other pinion.

FLOATER FOR GLASS FURNACES. 1,538,169. Apr. 7, 1924. Harry S. Conklin, Charleston, W. Va., assignor to Libbey-Owens Sheet Glass Co. Filed 4/7/24. The invention relates to a refractory floater for use in a glass tank, the floater having a glass retaining ledge along one side below the glass level.

GLASS FURNACE. 1,538,229. Apr. 7, 1924. James P. Weaver, Charleston, W. Va., assignor to Libbey-Owens Sheet Glass Co. Filed 4/7/24. The invention relates to the process of supplying molten glass to a glassworking machine, consisting in melting the glass, flowing the molten glass through a tank to the machine, and at an intermediate point along the side of the flowing stream allowing a portion of the surface glass to flow out and form cullet.

GLASS FURNACE. 1,528,215. Apr. 7, 1924. Joseph A. Reece, Toledo, O., assignor to Libbey-Owens Sheet Glass Co. Filed 4/7/24. The invention relates to a refractory floater for use in a glass tank, comprising a main glass obstructing portion, and a glass collecting trough in the top of the floater, one side wall of the trough being normally slightly below the glass level so that surface glass may flow into the trough.

PROCESS FOR SHAPING GLASS TUBES. 1,534,685. Apr. 21, 1925. Georges Claude and Jean de Beaufort, Boulogne-sur-Seine, France. Filed 12/21/23.

CLAMP FOR GLASS MOLDS. 1,534,878. Apr. 21, 1925. Thomas Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Co., Wheeling, W. Va. Filer 9/17/23.

BURNER HOLDING MEANS FOR GLASS LAMPS. 1,530,237. Mar. 17, 1925. James W. Collins, Sapulpa, Okla., assignor to the Bartlett-Collins Glass Co. Filed 6/4/24.

PACKING CASE FOR BOTTLES. 1,532,448. Apr. 7, 1925. Walter G. Seabold, Alton, Ill. Filed 6/27/21.

Glass Factory Equipment and Supplies

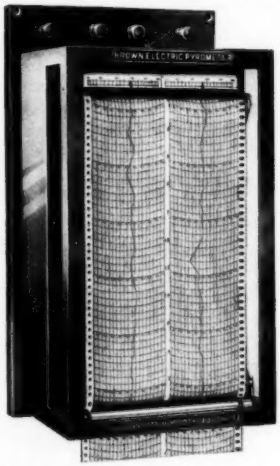
THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

Reducing Cost by Using Pyrometers

The A. C. Nielsen Company, Chicago, have recently completed a survey of the cost and efficiency of Brown pyrometer equipment in use by the Edward Ford Plate Glass Company at their Rossford, Ohio, plant. The following represents the findings of the engineers making the investigation in collaboration with the owners. The report has been certified by A. H. Stebbins, chief electrical engineer of the Edward Ford Plate Glass Company.

In the manufacture of high grade plate glass the accurate control of temperatures is very important. This is particularly true in the process where the silica sand and other materials are melted and fused before being cast ready to roll into the rough glass.

The fusing requires very high temperatures which, unless well controlled, are apt to break the pots holding the materials. On the other hand, if the process is carried out with temperatures that are too low, the quality of the glass will be impaired. To guard against such contingencies, recording pyrometers are in general use in the plate glass industry.



THE BROWN RECORDING PYROMETER

The great importance of the work done by the pyrometers is indicated by the fact that the present production on 16 furnaces is about 1,500,000 square feet of plate glass per month.

The furnaces are fired by producer gas and each one contains 20 melting pots 54 inches in diameter. On the average, 27 hours are required for each melt. The pyrometers indicate and record the temperatures continuously for each furnace and every 24 hours the record sheets are torn off, dated and filed for reference whenever required.

During the process, a temperature of 2,600° F. is maintained for five to six hours. This high temperature, together with the action of the flux used, brings about unusually difficult operating conditions. However, by packing the thermo-couple tubes in a material made of old melting pot shells crushed to a coarse granular fineness, these conditions have been largely overcome. Silica blocks provide the outer protection for the tubes which are located in the arches of the furnaces.

Daily Operating Cost

Brown recording pyrometers are used. About every two weeks the pyrometers are checked by means of a Brown potentiometer reading to 1/50 of a milli-volt. This is done to determine any slight change of lag that may have occurred.

With the present arrangement for protecting the thermo-couple tubes, they last as long as 18 months. Maintenance and repairs are amply covered by $100 a year for each pyrometer. As shown in the accompanying table, the total daily cost including depreciation and charts is only 42 cents per instrument.

The temperatures of the melts were formerly gauged by observing the color of the melt and the viscosity. By these methods it was rarely possible for even the most expert man to determine the true temperature within 200° F. Not infrequently, a melting pot was cracked, with the loss of the pot and the melt, due to allowing the temperature to become too high. This was injurious to the furnace and involved an appreciable loss in fuel gas. These losses have been eliminated by the pyrometers, and it is estimated conservatively that the instruments save over $6,000 annually. This means that they repay their original cost each year.

What is perhaps more important is the fact that they are a valuable aid to the maintenance of a high standard of quality by indicating and recording any tendency to allow low temperatures to prevail during a melt. Each morning the charts are carefully inspected by an executive and a check-up is made whenever they show that incorrect temperatures were allowed.

Since the scale on the pyrometers is easily and directly read, the furnace firemen or melters use the pyrometers without difficulty. The reliance placed on the instruments is shown by the fact that the melters insist on having them connected at all times.

Cost of Operation—Brown Recording Pyrometers

Depreciation—$400.00 (including installation) ÷ 10 years	$ 40.00
*Average interest at 6%—11/10 × $400.00 × .06 + 2....	13.20
Repairs and maintenance (including charts).....	100.00
Total annual cost, per instrument.....	$ 153.20
Total daily cost — $153.20 ÷ 363 days.....	$ .42

Saving Effected by 16 Pyrometers

Elimination of the following losses:

1. Loss of pots due to excessive temperatures
2. Loss of melts when pots cracked
3. Loss of fuel gas when pots cracked
4. Damage to furnaces due to excessive temperatures

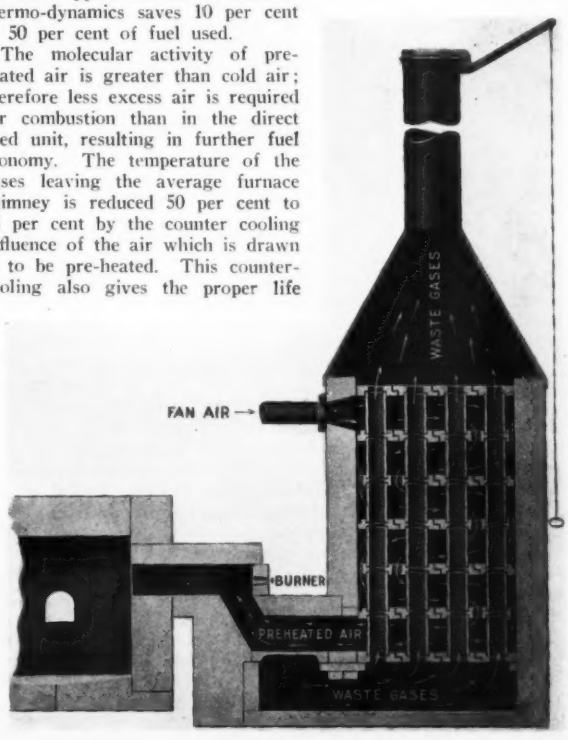
Estimated value of this saving per year.....$6,000.00

* Allowing for interest earned by depreciation reserve.

Amco Recuperators Applied to Day Tanks

The Amco Recuperator illustrated here is utilized to pre-heat air for combustion, with waste heat, to effect furnace efficiency. The waste heat is circulated through hollow clay (not-metallic) tube units in passing to the stack and cold air descends around the tubes accumulating heat, through the thin high-grade refractory walls, to be returned to the furnace. This scientific application of the laws of thermo-dynamics saves 10 per cent to 50 per cent of fuel used.

The molecular activity of pre-heated air is greater than cold air; therefore less excess air is required for combustion than in the direct fired unit, resulting in further fuel economy. The temperature of the gases leaving the average furnace chimney is reduced 50 per cent to 75 per cent by the counter cooling influence of the air which is drawn in to be pre-heated. This counter-cooling also gives the proper life



AMCO RECUPERATOR

to the well-designed recuperator by preventing excessive temperatures. The recuperators can be used to increase the efficiency of continuous glass tanks, day tanks, revolving pots and pot furnaces in the glass industry, where they have been a proven success.

Twelve recuperators have been built and are under contract. The largest one in operation is that applied to a 14 x 18 ft. tank at the Carr-Lowrey Glass Co., Baltimore, and the next largest at the McLaughlin Glass Co., Los Angeles. These recuperators are giving successful results, showing, it is claimed, 50 per cent less fuel consumption and 50 per cent increased production.

The Glass World and What It Is Doing

News of the Industry

New Plate Glass Plants Beginning Operations

An immense increase in the country's capacity to produce polished plate glass is taking effect with the beginning of manufacturing operations last month in the large new grinding and polishing plant of the Libbey-Owens Sheet Glass Company at Toledo, O., and in lighting of fires in the enormous new plate glass producing, grinding and polishing works of the National Plate Glass Company at Ottawa, Ill.

The first-mentioned concern, as stated by its president, E. B. Libbey in his most recent annual report, is designed to accommodate 109 grinding and polishing machines. Several units have already been put into operation on plate drawn by the Libbey-Owens process at the company's Charleston, W. Va., factory and shipped to Toledo for finishing, which is the basis on which the new plant will be operated indefinitely.

The new plant of the National Plate Glass Company at Ottawa will employ about 1,200 men and is expected to add to the already large capacity of the company's present plants an increase of approximately 1,000,000 sq. ft. of glass per month—a capacity it is claimed exceeding that of any other single plate glass factory in the world.

Some interesting data concerning the new plant are given in a recent article in the Ottawa (Ill.) *Journal*, from which the following is abstracted.

The pot house is 160 x 400 ft. in size, 4 stories high, with 6½ acres of floor space. About 50 men will be employed in it. Two thousand melting pots each weighing nearly a ton and a half will be kept on hand at all times. The batch storage plant is 34 x 230 ft. It contains 12 bins, two for sand 24 ft. in diameter and 26 ft. high, with a capacity of 1,356 tons each, or a total of approximately 60 railroad cars full. The two lime bins of the same size have a capacity of 2,400 tons. The soda ash bins are a little larger and have a capacity of 1,100 tons. There are four salt cake bins with a capacity of 50 tons each, and two salt bins with a capacity of 25 tons each. One month's supply, amounting to 6,500 tons, or 16 carloads, can be kept in the bins. Twenty men will operate this department.

There are two gas producer units each capable of gasifying 300 tons of coal a day.

The furnace building, or casting hall, is 168 ft. wide and 840 ft. long and has a floor space equivalent to five acres. There are eleven 20-pot ovens, besides the necessary kilns or arches for preheating the pots.

A continuous pot pre-heating kiln 250 ft. long prepares the pots for use. After being put in the furnace they are automatically filled with batch materials. There are four pot-filling machines. When ready for casting, teeming cranes pour the molten glass on to casting tables 16 x 28 ft. in size, where a 15-ton roller flattens it into ½-in. plates. From the table the plate goes into the lehr, a series of five ovens ranging in temperature from 1,200° down to 150°, with a runway of 390 ft. and a capacity of 26 plates. One plate can be cast every six minutes. About 250 men will be required in this department when running at full capacity.

The rough-glass building is 172 ft. by 572 ft., and has an area equivalent to two and one-half acres. All glass is handled by crane and trolleys and the racks have a capacity of 1,250,000 sq. ft.

The room in which the grinding and polishing takes place is 172 ft. by 1,092 ft., and covers four and six-tenths acres. There are 250 carloads of machinery installed in this structure. There are 30 tables, 36 ft. in diameter, weighing 110 tons each, on which the glass is ground. There are eight grinding and eight polishing machines.

The final cutting and inspections are done in the wareroom, a building 156 ft. by 570 ft. with an area of two acres. Storage racks have a capacity of 1,000,000 sq. ft. Two hundred men are needed here.

Motor power for 14,100 horsepower is generated in the power plant for the 250 motors scattered about the plant. The power plant is 57 ft. by 152 ft. and has eight 600 horsepower boilers, which develop the power for three turbines of 3,500 k. w. each, or 15,000 horsepower. All of the fire equipment, which consists of 25 pumps that can draw 40,000 gallons a minute from the river, are operated from this building.

Seventy-five men will be employed in the machine shop.

The National Plate Glass Company is a subsidiary of the Fisher Body Corporation, which in turn is controlled by the General Motors Corporation. H. J. Eckenrode is president of the National Plate Glass Company and J. M. Berg, is general manager and in charge of the company's two plants at Ottawa and others at Saginaw, Mich., and Blairsville, Pa.

Glass Container Association

In a report to the Glass Container Association at its meeting at Atlantic City, April 30 to May 2, Judge I. G. Jennings, business director of the association, reviewed the history and work of the organization, and discussed its aims and the possibilities of the future for the continuance and extension of its usefulness to the industry. Part of his remarks follow:

The glass container industry is today engaged in a well defined co-operative movement. Is it justified? This can best be determined by analyzing the situation in which we find ourselves and by appraising the character and some of the results of the organization we are maintaining.

Six years ago, the manufacturers of glass containers asked themselves if they would be content in the future to rely upon the drug and beverage field for their business. Prohibition had taken away a large proportion of their most profitable business. The tendencies in the drug business were in the direction of pills and tablets which were cutting down the number of bottles even in this field. There could only be one answer, and that was that the glass container industry must be organized for the purpose not only of maintaining its then present position, but of increasing its business in other fields.

The Glass Container Association was organized and some of the best men in the industry have devoted much time, energy, and brains to its work. They have found the proposition a big one, the difficulties great, and that it will take time to get the desired tangible results, but they have also found that if nothing effective is done, the glass container industry stands to lose much that it now has.

The aim of the association, today as in the past, is to lay the foundation for bigger business through the development of good will, to provide better contact opportunities for its members, to do work both constructive and protective. It has been called upon during the past year to do both kinds of work and it did the work.

The prestige of the Association everywhere has increased; its work has become better known; its personnel is high class throughout; its spirit is excellent. Your work is being well done, and with all this the Association is running well within its income.

During the past year, the association as a whole, and in conjunction with its several departments, has accomplished and is accomplishing many valuable things for the glass container industry.

Legislatively (and we hesitate to mention this hackneyed subject again, although our activities this year were probably more effective and the danger greater than at any time before), well—we are glad to say that the Haugen Bill has not yet been born. We

believe it would have been a law if it had not been for the persistent opposition of the Glass Container Association. This organized opposition certainly stands to the credit of the Glass Container Association for many of our former co-operators got cold feet this year.

The accomplishment of the Traffic Department during the past year has been most valuable. Its policy with the railroads is that of "live and let live," and yet the manufacturers of glass are still enjoying their commodity rates which have been threatened for almost two years. The great food case, organized and engineered largely by the Traffic Department, has reduced rates very substantially on food products packed in glass containers. The result of this Interstate Commerce Commission decision is bound to reflect itself in greater sales of glass containers as time goes on. The need for the work of the Traffic Department in the future is even greater than it has been in the past. Such work could not be done effectively if it were not for the Glass Container Association.

No research work of any kind, any place, has been more effective than that of your Research Department in the State of California. Through the work of our Research Department our prestige with scientific men and packers is growing by leaps and bounds. Our Research Department is well-organized, well-housed, well-equipped. The glass industry is getting big returns from this work, most of which is being plowed under for future distribution.

It may also be said that the Business Department, and every ounce of energy that it, and its entire staff possesses, has been behind and has helped to put over the important projects of every other department in the Association. All this may not seem modest to say, but we think for once it will not hurt to tell it.

Yes, the Glass Container Association can be made better. When the courts clear up the atmosphere as to what is and what is not legal in the way of trade association activities, new departments of work can be added to our association which may be of even more direct and tangible value to our industry than those we are now maintaining. In the meantime, we are doing what we know we can do. As it is our Association, it is as clean as a whistle and stands high in the estimation of those who make it their business to probe into association affairs.

It is my sincere conviction that the Glass Container Association is one of the best, most progressive and most useful trade associations in the country.

Sillimanite Mine Discovered in India

A mine containing large quantities of sillimanite has been discovered in India and the right to work it has been acquired by Henry A. Golwynne, a New York importer of chemicals.

The mine is about 100 miles from Calcutta and within 2 or 3 miles of a railway. At present the ore is carried to the railway in bullock carts but a spur line direct to the source of supply will be constructed. The extraction costs are small, for the ore lies on the surface of the ground in tremendous boulders, some of them as much as 100 yards wide and 100 yards long.

This is the first deposit of sillimanite in large quantities to be discovered. The mineral has long been desired by users of refractory materials. The United States Bureau of Mines has experimented for years in an attempt to produce artificial sillimanite.

The value of sillimanite as a refractory material has been known for some time. Sillimanite has many valuable properties which render it suitable for use as a refractory material amongst which are strength and toughness, a high melting point, (1810 degrees centigrade) and stability at that temperature, low co-efficient of expansion, low electrical conductivity, freedom from volume changes, neutral reaction and resistivity to corrosive slags and to oxidizing and reducing conditions.

The following report on the possibilities of sillimanite was published in the *Journal of the American Ceramic Society*.

"The possible use of sillimanite as a refractory material is of interest because of the limitations of the usual refractories, fire clay silica, and magnesia brick in modern metallurgical processes.

The more universal use of the electric furnace with its high temperature and rapid thermal changes has increased this interest. The inadequacy of the present refractory linings resulting in a retarding in the development of the open-hearth steel furnace has caused a searching for a better refractory. Steel could be melted and purified faster if the furnace walls and roof would stand high temperatures. Insulation cannot be used at the present temperatures on silica brick roofs."

The efficiency of sillimanite is pointed out in the following quotations which are reprinted from the *Mining Journal* of London:

An ideal refractory for all purposes should fulfill the following requirements:

It should be capable of standing indefinitely, without softening, temperatures of from 1,450 degrees C to 1,750 degrees C.

The co-efficient of thermal expansion should be less than 0.000002.

It should carry a load of 20 to 30 pounds per square inch when part of a furnace in operation.

The hardness should be not less than that of quartz when exposed to working conditions.

It should have a neutral reaction so as to remain unaffected when in contact with acids or basic molten slag.

Sillimanite has a definite melting point about 1,830 C. and does not soften below this temperature, its coefficient of cubical expansion is exceedingly small, it is a chemical compound of great stability, and being neutral in composition is practically immune to attacks of acid or basic substances at all temperatures below its melting point.

The massive material sillimanite is one of the strongest and toughest minerals known.

Two defects appear in the manufacture of synthetically prepared sillimanite: the high cost of production and the lack of a suitable binder.

The Aims of the American Refractories Institute

William C. Sproul, former governor of the state of Pennsylvania, has recently accepted the presidency of The American Refractories Institute. This new organization was formed for the purpose of promoting the common interests of the manufacturers and consumers of refractory materials. There is a big need for heat-resisting materials that will withstand more severe usage than the modern products will bear, and it is planned to meet this industrial requirement through developments arising from research work carried on by the Refractories Institute. Laboratories and a corps of technical specialists are to be maintained at Mellon Institute for conducting tests on raw materials and finished products and to make investigations dealing with the problems of consumers as well as of manufacturers. For the first year this work is being largely sustained by the manufacturers of refractories, but it is planned to interest the users sufficiently that they will also participate in the support of the project. As great economies are possible, there is every reason to believe that the full co-operation of the users will be obtained.

WILLIAM C. SPROUL.
Ex-Governor of the State of Pennsylvania, President-elect of the American Refractories Institute.

Foreign Commerce in Glass Increases in March

Both exports and imports showed increased activity during March. Exports increased from $536,439 to $751,118. Imports increased from $1,379,975 to $1,406,231. Exports of window glass decreased $13,766, plate glass exports remaining practically unchanged as compared with the previous month. The value of glass containers exported increased from $180,649 to $266,113. Table glassware showed an increase of $47,209. The value of exports of other glasses of glassware also increased.

Although imports as a whole increased there was a decline in the importation of plate glass which fell from $634,664 to $593,531. There was some increase in the value of glass containers. Imports of table and kitchen utensils rose sharply from $4,305 to $25,377. Bulbs or electric lamps fell from $20,528 to $4,617. Other classes of glassware showed small changes.

The usual complete summary of March foreign commerce in glass and glassware is given on the last text page of this issue.

ROYAL PALACE AT BARCELONA, SPAIN.

American Glass in Spanish Palace

A recently completed Royal Palace built for the King of Spain at Barcelona was glazed with Libbey-Owens glass manufactured at Charleston, W. Va. The glass was shipped to Barcelona during the fall of 1923. The shipment included a quantity of 3/16th lights 9 feet long. Many very favorable comments regarding the good appearance of the glass have been made.

Society of Glass Technology

At the annual general meeting of the Society of Glass Technology held in Sheffield on April 22, Col. S. C. Halse was succeeded as president by T. C. Moorshead, director and general manager of the United Glass Bottle Manufacturers, Ltd. To fill vacancies on the council the following were elected: As vice-presidents, W. Butterworth, Jr., and J. H. Davidson; as ordinary members of council, B. P. Dudding, E. A. Hailwood, H. J. C. Johnston, E. Meigh, and G. Simpson. Councillor J. Connolly was re-elected general treasurer, and W. M. Clark, American treasurer. Professor W. E. S. Turner was appointed honorary secretary and C. S. Davey and Dennis Wood were elected auditors. The retiring president, Col. S. C. Halse, took as the subject of his presidential address "The Present State of the British Glass Industry." He pointed out that in certain important branches of the industry the wholesale introduction of automatic machinery had considerably reduced the number of men employed while the production was simultaneously greatly increased.

At the ordinary general meeting which followed the annual general meeting, the society departed from its usual practice of having a series of technical papers. Instead, Professor Turner, at the invitation of the council, delivered a popular illustrated lecture on "Glass as an Instrument of Human Progress."

Chemical Equipment Manufacturers Exhibition

Having in the last few months organized, with the endorsement of the American Institute of Chemical Engineers, a first Chemical Equipment Exposition, the Association of Chemical Equipment Manufacturers announces that it will be held in Providence, R. I., June 22 to 27, inclusive, 1925, with a large number of exhibitors showing their products.

This association, comprised of makers of equipment used in the various chemical processes in industry, of material handling of solids, liquids and gases, heat combustion, heat transfer, refrigeration, crushing, grinding, pulverizing, mixing and agitation, mechanical separation, thickening and settling, filtration, hydraulic separation, centrifugal separation, separation affecting solids and gases, dissolving, leaching and extracting, evaporation, distillation, drying, precipitation and crystallization, absorption, is said to represent a physical valuation among its membership, all of which are American companies, of some $600,000,000.

The exposition is intended to be made a medium for the exchange of both technical and practical manufacturing information as well as for direct sales transactions involving equipment essential to the chemically controlled phases of any industry. The headquarters of the Association of Chemical Equipment Manufacturers is at 1328 Broadway, New York.

Motor Lights Approved

The Motor Vehicle Bureau of the state of New York has given out a list of headlights that have been approved and from which automobile owners may make a selection before July 1, the date on which a drive will be inaugurated against headlights that do not comply with the bureau's regulations. The six months' notice required by law will expire July 1.

The list of lights that have the approval of the bureau are:

Automobile—Alphe Company; Lee Knight; Bausch & Lomb; Legalite M111; Benzer, Type A; Liberty; Brown Universal (reflector); Liberty, Type D; Conaphore, Type F (clear or amber); Lincoln Projector; Macbeth, Type D; D. B. (Dodge Brothers, "82" only); McKeelite; Deglarescope; Miro-Tilt (headlamp); Dillon, Type 1; Monogram; E. and J., Type 20 (headlamp); Osgood B23; Flat Lite Standard (reflector); Patterson; Flintex; Parab; C. Lite, Type F. W.; Ford H. (81½ only); Smith; Guide Ray, Type A (headlamp); Spreadlight; Holophane No Tilt Standard; Hudson (8½ only); Johnson.

Motorcycle—Conaphore, Type F; Patterson; McKeelite Spreadlight; Monogram Standard.

All Motor Vehicles—Acetylene lamps with 6-inch mirrors, 5/8-inch burners and clear glass fronts.

The above have been approved by the Eastern Conference of Motor Vehicle Administrators and are good in all Eastern States. Lighting devices from which approval has been withdrawn and which will be under the bureau's ban in a few weeks are:

Clamert lens, paraflector; Fracto-Lite; Primolite lens; Green Moon; Revelo; Hocking glass lens; Saferlite; Killglare lens; Shaler Roadlighter (new); Lancaster Beam Control, Type A; Superfit lens; MacDonald optical lens; Universal lens; McKee lens, Type M; Victor; McKee Fluted, Type D; Violet Ray lens; National lens.

Headlights must comply with two fundamental provisions, Commissioner Harnett said. First, they should give a good driving light, and second, they should not project any glaring or dazzling light high enough to interfere with an approaching driver.

"These two provisions," Commissioner Harnett added, "are made by the present Motor Vehicle law, which states in substance that headlamps shall reveal substantial objects at 200 feet in front of the lamps, and that no glaring or dazzling light should be projected above the 42-inch line at 75 feet or more in front of the lamps to the left of the axis of the vehicle."

Summer Meeting of American Ceramic Society

Ross C. Purdy, general secretary of the American Ceramic Society, has announced the following program for the Summer Meeting, July 4-11, inclusive, 1925:

Leave Rochester, N. Y., Saturday afternoon for night boat ride across Lake Ontario to Kingston.

Day ride Sunday down St. Lawrence River through the Rapids and Thousand Islands to Montreal.

Re-embark immediately for night ride on the St. Lawrence —in Quebec Monday morning.

Monday—in and about Quebec.

Tuesday—Ceramic mines and plants south of St. Lawrence en route to Montreal.

Wednesday—in and about Montreal.

Thursday and Friday—in and about Toronto.

Saturday—Niagara Falls or Hamilton.

The Canadian Department of Mines, the Canadian National Clay Products Association, and the University of Toronto are making detailed itinerary and meeting plans, announcements of which will be made as they develop. Additional optional plans will be made for those who wish to spend more time in Canada. Complete time and expense schedules will be furnished soon.

The important thing, says Mr. Purdy, is for you to mark July 4 to 11 inclusive on your calendar as a week of exceptional recreational and informational opportunity with fellow ceramists from all parts of the continent.

Window Glass Prices Reduced

The American Window Glass Company announced on May 16 a reduction averaging about 8% in prices effective May 9, 1925, on window glass in carload lots for shipment to all zones except zone A.

Ross C. Purdy Resigns

The board of trustees of the American Ceramic Society, through President E. Ward Tillotson, recently informed members of the society that Ross C. Purdy has announced his wish to discontinue as secretary of the society on March 1, 1926. The board has been loathe to grant this request and the members of the society will be disappointed to learn that the secretary has found it necessary to give up the office in which he is serving the society so well. Mr. Purdy will continue as secretary of the society during the remainder of his term. When he leaves the office, he has promised to be as active in constructive service to the society as in the past.

A successor has not yet been appointed. The board invites the cooperation of the society in selecting a worthy successor of Mr. Purdy.

Receivers Appointed for the Interstate

The Interstate Window Glass Company went into a voluntary receivership on May 2 when Federal Judge W. E. Baker at Wheeling, W. Va., appointed as receivers V. L. Highland, a banker of Clarksburg, W. Va., and R. A. Hill of Kane, Pa. Inability to market its products under present conditions without making big sacrifices was given as the reason for the action. According to the company's petition, the company has outstanding 55,846 shares of no par stock, 27,374 shares of 7 per cent preferred stock at a par value of $2,737,400, outstanding $2,221,500 worth of first mortgage eight per cent bonds, 375,000 boxes of window glass, valued at $1,330,000, ten manufacturing plants and cash on hand of $60,000. The boxes of glass are pledged as collateral for a loan of $583,765.

The bill of particulars supporting the motion shows the defendant company has a mortgage with the Guarantee Trust company of New York for $2,225,000 and other outstanding obligations of $547,000 with outstanding notes payable of $92,444 and invoices payable totaling $325,000.

Pittsburgh Sheet Glass Co. in Voluntary Receivership

Edgar B. Stewart of Morgantown, W. Va., and John J. Donnan of Washington, Pa., have been appointed ancillary receivers of the Pittsburgh Sheet Glass Company, a West Virginia corporation, with offices at Morgantown, by Judge F. P. Schoonmaker in United States District court, following the filing of a suit in equity against the company by Walter A. Jones of Columbus, O., president of the company and a creditor. They will assume charge of the Pennsylvania assets of the company including its plant at Washington, Pa.

The plaintiff avers that while the company is solvent and has assets in the form of machinery and plant equipment which are in excess of its liabilities, it has no funds in its treasury and is unable to secure further credit to pay any of its debts or to carry on its business.

April Building Contracts Broke Record

Building construction in New York City revived in April at a rate that in the light of the first-quarter decline will make this year memorable to many a manufacturer, writes Allen E. Beals in the Dow Service daily building reports.

Early in April New York building construction was 36.3 per cent by volume below the first-quarter record for 1924. At the close of the month plan filings were within 3.5 per cent of the recorded plan filings for the period January 1 to April 29, 1924. It has seldom happened that the pendulum of building activity has made such a speedy return swing and has covered so great a loss in so short a time.

Bullet-Proof Glass Stock Promoters Indicted

Sealed indictments by the Federal Grand Jury were opened at New York recently naming eight defendants as having swindled investors out of more than a million dollars by inducing them to buy stock in a concern which they represented to be profitably engaged in the manufacture of bullet-proof glass. Ground for the swindle was prepared in 1920 when the Bankers' Protective Appliance Corporation was formed. This was followed in 1923 by the organization of the Bullet-Proof and Non-Shatterable Glass Corporation, the Bullet-Proof and Non-Shatterable Glass Company and the Armor Plate and Non-Shatterable Glass Corporation.

Of the eight defendants one has not yet been located and a bench warrant was issued for his arrest. The other seven are Adolphe Topper, Samuel L. Krantz, Harry L. Gold, Irving Sass, Abraham A. Lichtman, John S. Concannon and David Greenwald. The evidence indicates that the various companies organized to advance the swindle made no glass of any kind in quantities.

Illuminating Glassware Convention

The first joint annual convention of lighting fixture manufacturers, dealers and salesmen will be held at the Ambassador Hotel, Atlantic City, N. J., June 17, 18 and 19. It is planned to make this the most constructive convention in the history of the lighting fixture trade. The following organizations will take part: the National Council Lighting Fixture Manufacturers, the National Association of Lighting Equipment Dealers, the Illuminating Glassware Guild and the Associated Lighting Equipment Salesmen of America.

Special rates have been granted by the hotel and it is expected that special railroad rates will be arranged.

Glass Freight Rates Declared Unfair

In a report filed with the Interstate Commerce Commission, by its examiners, the freight rates on glass now maintained by the railroads to and from the Monongahela Valley cities in West Virginia, including Clarksburg, Fairmont, Grafton, Morgantown and nearby points were held to be unreasonable and it was recommended that a readjustment be made on the basis of distance, which would result in reductions ranging from 2 to 5 cents per hundred pounds under present charges.

New Milk Bottle Law

A new Pennsylvania law went into effect on May 25 providing that no "loose milk" may be served in the state after that date. All milk must be sold to patrons in the original packages which may consist of glass bottles or paper containers. It is reported from Harrisburg that experimental work is going on designed to perfect a paper carton for this purpose.

Complaint Against Owens Bottle Company Dismissed

The Federal Trade Commission at Washington dismissed on May 13th the complaint against the Owens Bottle Company for alleged violation of the Clayton act. It was charged that the Owens Bottle Company by acquiring stock interests in certain other glass companies had acted in restraint of trade.

No proof of this was found by the commission.

A new record in plate glass production in the United States was made in April when the output amounted to 9,848,320 sq. ft. This was 74,363 sq. ft. above March production.

Trade Activities

The Bournique Glass Company, Kokomo, Ind., has filed a final certificate of dissolution.

The Delmar Glass & Mirror Company, 118 Market street, St. Louis, Mo., has been incorporated.

The Indianapolis Glass Company, Indianapolis, Ind., has increased its capital stock from $50,000 to $120,000, the increase being preferred stock.

The American Plate Glass Manufacturers Corporation was incorporated at Dover, Del., on April 21 with a capital of $9,100,000, to deal in plate glass.

The Pittsburgh Plate Glass Company met with a severe loss when the building housing their Memphis, Tenn., branch was destroyed by fire on April 29.

The American Manganese Steel Company, Chicago Heights, Ill., makers of castings for furnaces and other purposes, have placed a new foundry in operation at Los Angeles, Cal.

The Sheffield Glass Bottle Company, Sheffield, Pa., has resumed the manufacture of amber bottles in their small tank which had been shut down for repairs. W. B. Keefer is manager and treasurer.

The American Window Glass Company, through its board of directors has voted a gift of $25,000 to the building fund of the "Cathedral of Learning" which the University of Pittsburgh proposes to erect.

The Republic Flow Meters Company, Chicago, Ill., announce the opening of a factory branch office at 617 Engineers Building, Cleveland, O. L. C. Wilson, formerly of the Pittsburgh office, will be in charge.

Henderson Brothers, 114 East 41st Street, New York, manufacturers of leaded glass, etc., have purchased the four-story building at 230 East 41st Street, adjoining property which they already owned and which will be used also for a new plant.

The Hyatt Glass Company, Inc., Poteau, Okla., of which W. G. Twyman is president and G. M. Twyman, secretary and treasurer, are operating an 18-ton continuous tank with two rings; three shops on cylinders for gasoline pumps and one on 5-gallon water bottles.

The Thompson Glass & Paint Company, 800 East 16th Street, Los Angeles, Cal., are building a new $23,000 factory at Stanford and Merrill Avenues, 173 feet square, and installing a mirror beveling and silvering plant. A full stock of building glass is also carried.

The Pittsburgh Plate Glass Company is reported to have taken title to a tract of about 10½ acres of land along the Allegheny River lying partly in the borough of Tarentum, Pa., and partly in East Deer township. The consideration is supposed to be in the neighborhood of $52,500.

The Root Glass Company, Terre Haute, Ind., had their No. 2 glasshouse destroyed by fire on the night of May 15, with a very heavy loss. This building adjoined the No. 3 glasshouse which was destroyed by fire last November, but which has been rebuilt since then.

A West Virginia bottle manufacturing plant will dismantle its plant and will re-establish it at Provo, Utah, according to a statement made by Frank C. Murphy, industrial secretary to the Salt Lake City Chamber of Commerce. The new plant will use as fuel the surplus gas available from the Columbia Steel Company's plant.

The Webster Manufacturing Company, Chicago, Ill., manufacturers of conveyors and other material handling equipment, announce the opening of a branch sales office at 811 Magee Building, Pittsburgh, Pa., in charge of E. E. Landahl who has been associated with the company for the past thirteen years.

H. L. Dixon Company of Pittsburgh announce that they have recently secured the service of Ray S. Godard, who for a number of years was employed as construction engineer for the Illinois Glass Company. Mr. Godard has a wide circle of friends in the glass industry and will be a valuable asset to the Dixon Company.

The board of directors of the **Libbey-Owens Sheet Glass Company,** Toledo, O., at a meeting held on May 12 declared the regular quarterly dividend of 1¾ per cent on the outstanding preferred stock and 50 cents per share on the outstanding common stock, same to be payable June 1, 1925, to stockholders of record at 3 P. M., May 22.

The Tyre Brothers Glass Company, 666 Townsend Street, San Francisco, Cal., it is reported have had plans prepared by M. H. Lanzit, engineer, for the erection of a concrete and steel factory building at Oakland, Cal., at a cost of about $40,000. It is also reported that the factory will be equipped with modern machinery for glass manufacture.

The Dualite Electric Lamp Company, with offices at 1170 Broadway, New York, was recently incorporated to manufacture a new type incandescent lamp. The officers are: Otto B. Shuloff, president; James W. Gerard, former Ambassador to Germany, vice-president; Marcus Daly, treasurer and James J. Sheriden, secretary. The company is operating a plant at St. Marys, W. Va.

The Citizens Glass Company, Barnesville, O., at a recent meeting of stockholders voted to increase the capital stock to $300,000 for the purpose of installing sheet drawing window glass machines. Jules L. Biron announced for the company that as soon as the increase of capital stock and bond issue was authorized by the State, work would start immediately. It is planned to install six machines.

The Austin Company, engineers and builders, Cleveland, O., announces the removal of its New York office to larger quarters in the Equitable Building, 120 Broadway. J. K. Gannett is the district manager and is assisted by A. D. Engle and D. C. Raymond. The Austin Company reports an increasing volume of industrial construction on the Atlantic Seaboard during the past few months.

The Knox Glass Bottle Company, Knox, Pa., is not connected in any way with the Marienville Glass Company which has been widely reported as having been taken over by the former concern. R. R. Underwood of the Knox company states that while that company is not interested, he is personally interested and that it is quite possible that the Knox company will purchase a goodly portion of the Marienville company's output.

The Winslow Glass Company, Columbus, O., suffered a loss by fire when a 150-ton glass tank burst on May 4. The damage, which was estimated at about $75,000, was confined to two buildings of Factory B where the tank was located. No damage was done to the Company's Factory A and operations were resumed in that plant the next day.

The Crescent Bottle Company, McDonald, Pa., after running its factory at a loss for nearly two years, has decided to liquidate. Molds are to be shipped to the Tibby-Brawner Glass Company at Punxsutawney, Pa. After operating for more than 25 years the company has succumbed to the competition of machine plants. The Punxsutawney plant is one of the very few factories in the country that still makes bottles by hand.

The Buckeye Sheet Glass Company, Columbus, O., a reorganization of the old Buckeye Window Glass Company, with a capital of $1,500,000 is planning to manufacture sheet and plate glass by means of a machine patented by W. E. Bock of Toledo. Officers of the Buckeye Sheet Glass Company are: Charles T. Bartram, president; W. E. Bock, first vice-president; C. E. Bartram, Jr., second vice-president and secretary; G. C. Scott, treasurer; executive committee, C. E. Bartram, G. C. Scott and H. D. Shepard.

The Pittsburgh Plate Glass Company has announced through H. L. Halbach, manager of the company's plant at Norwood, Clarksburg, W. Va., that a new melting tank and additional gas producers are to be installed at the factory at a cost of approximately $100,000. The plant now has one tank and four producers. A large amount of natural gas is also used at present, but it is planned to install eight more producers along with the new tank. About 200 men are now employed and with the new plant in operation about 100 more will be required.

The Beaver Glass Manufacturing Company, chartered under the Delaware laws with a capital of $500,000 in April, 1924, has acquired the factory formerly known as the Mid-Way Glass Company, Compton, Cal., and begun the manufacture of 5-gallon water bottles and a new type of fruit jar and other containers will be made in the near future. The plant is equipped with a 30-ton continuous tank and four lehrs. Elmer Beaver is president and H. E. Charrey is vice-president and general manager. E. E. Fitch and H. H. James of Los Angeles are directors. The main office of the company is in the W. M. Garland Building, Los Angeles.

The Warren Company, Atlanta, Ga., has just acquired an additional twelve acres of land adjoining their present plant, which increases their total factory site to approximately thirty acres. V. P. Warren, the president, stated that the architects, Lockwood, Greene & Company, are perfecting plans for the largest and most modern glass distributing warehouse in the South, which will be equipped with overhead traveling electric crane for convenience in handling large plate glass and all kinds of rough rolled glass. The new additions to the paint and glass division alone approximate 114,050 sq. ft. of floor space, all of which will be of concrete and steel construction. Improved machinery will be added to the mirror and beveling plant, which at the present time is one of the largest and most modern in the south.

Personals

Irving E. Adams, after devoting the past several months to the interests of the Continental Flat Glass Company, Shreveport, La., has resumed his general glass consulting practice at his former address, 340 Spring street, Reading, Pa.

North Storms, secretary of the Glass Distributors' Association and western representative of the Plate Glass Manufacturers of America, has moved his office from 111 W. Monroe street, to the Tribune Tower Building, Chicago, Ill.

H. Hofmeister, director of the concern which produces Grossalmerode clay in Germany, with several associates in the same organization has been visiting the glass trade in several sections of the country.

R. L. Frink, the well known American glass expert, formerly director of research for the Glass Research Association in England, has been in this country for several weeks, making his headquarters at his old home, Lancaster, O. Mr. Frink expects to return to England shortly.

Donald Robertson, whose article in this issue describing glass making in Indo-China is based on his experience in a glass factory at Haiphong, is now on his way to the United States via the Philippine Islands, and will probably arrive early in the fall.

D. D. Schurtz, president of the Sharp-Schurtz Company, chemists and consulting engineers to the glass industry, Lancaster, Ohio, has recently returned from an extended trip to the Pacific Coast, where he carried on experimental work for the western branch of the Western Glass Company.

What Our Advertisers Are Doing

THE CHAPMAN-STEIN FURNACE COMPANY, Mt. Vernon, O., recently received a contract from the Fenton Art Glass Company, Williamstown, W. Va., for a complete recuperative day tank to be used in the manufacture of both opal and crystal glass. A similar Chapman-Stein recuperative tank put into operation at the Lancaster Glass Company, Lancaster, O., has proved successful and is using, it is claimed, less than one-half the fuel formerly consumed.

Coming Meetings

THE NATIONAL COUNCIL OF LIGHTING FIXTURE MANUFACTURERS, NATIONAL ASSOCIATION OF LIGHTING EQUIPMENT DEALERS, ILLUMINATING GLASSWARE GUILD AND ASSOCIATED LIGHTING EQUIPMENT SALESMEN OF AMERICA will hold a joint convention at the Hotel Ambassador, Atlantic City, N. J., June 17, 18 and 19.

AMERICAN CERAMIC SOCIETY will meet at Rochester, N. Y., July 4 and begin a trip extending to July 11, through the Thousand Islands to Montreal and Quebec. On the return trip stops will be made at Montreal, Toronto, Niagara Falls and Hamilton. The fall meeting at New York City will be held October 1, 1925, and the annual meeting at Atlanta, Ga., February 8-13, 1926.

AMERICAN FLINT GLASS WORKERS' UNION annual convention will be held the first week of July, 1925, in Toledo, O. Following this meeting the annual wage conferences with the manufacturers' committees will be held at Atlantic City.

AMERICAN ASSOCIATION OF FLINT AND LIME GLASS MANUFACTURERS will hold their annual meeting at Atlantic City, July 13 and will confer with the workers on July 15.

THE NATIONAL ASSOCIATION OF MANUFACTURERS OF PRESSED AND BLOWN GLASSWARE meet at Atlantic City, July 13 to prepare for the joint convention with the workers' representatives on July 15.

THE NATIONAL ORNAMENTAL GLASS MANUFACTURERS ASSOCIATION will hold its annual convention at the Hotel Schenley, Pittsburgh, Pa., June 22 to 25.

THE GLASS BOTTLE BLOWERS ASSOCIATION will meet the first week of July at Atlantic City and a final conference between the association and the manufacturers will be held on July 28.

THE MIRROR MANUFACTURERS ASSOCIATION, according to an announcement sent out by H. C. Sorden, secretary, will hold their next national conference on June 3 at the William Penn Hotel, Pittsburgh, Pa. The plate glass manufacturers will be represented at the meeting.

FIRST CHEMICAL EQUIPMENT EXPOSITION will be held at Providence, R. I., June 22 to 27, 1925, under the auspices of the Association of Chemical Equipment Manufacturers, 1328 Broadway, New York.

TENTH EXPOSITION OF CHEMICAL INDUSTRIES will be held at Grand Central Palace, New York, September 28 to October 3, under the management as usual of the International Exposition Company, 480 Lexington Ave., New York.

What the World Wants

Specific inquiries for American goods received in the Department of Commerce.

England. 14774, glassware.
Australia. 14782, optical goods.
India. 15045, assorted glass bottles; 15048, cylindrical glass bottles.
Canada. 15038. gas and electrical glassware, 15043 common table glassware in carload lots.

Commerce Reports of May 18 announces that catalogs relating to the pottery and glass industries are requested by the American consulate in Darien, Manchuria, for its commercial reference files so that it will be in the best possible position to answer inquiries concerning these American products.

Inquiries Received

For Further Information Address THE GLASS INDUSTRY

268. Please wire the names of manufacturers of small jars for library paste and mucilage. Must be water-well type with brushes. (May 18.)
269. We should like to have the names of one or two firms which manufacture machinery for making agates or glass marbles. (May 18.)
270. Who manufactures machinery for etching sheet or plate glass? (May 12.)
271. We desire to obtain considerable quantities of stoppers for unrefillable bottles. (May 27.)

Stock Quotations

Reported by Moore, Leonard & Lynch, Union Trust Bldg., Pittsburgh, Penna.

PITTSBURGH STOCK EXCHANGE, MAY 22, 1925

	Bid	Ask	Last
American Window Glass Machine, com...	88	89	89
American Window Glass Machine, pfd....	94	95	95
American Window Glass, preferred.....	110	113	112
U. S. Glass.....	12	15	15
Pittsburgh Plate Glass.....	289	290	289
Standard Plate Glass, common.....	10½	11	11
Standard Plate Glass,			
Preferred cumulative	72	73	72
Prior	91	94½	93¾

Glass stocks on the Pittsburgh Stock Exchange gained strength during May. Demand has been considerably stimulated for plate glass due to the recent price cuts, the latest of which was a reduction of 8 per cent. Plate glass is continuing in record production, as March also registered extremely high activity and broke the United States production record.

The automobile industry, a large user of plate glass, is now running at approximately the highest rate since the Spring of 1923 in the passenger car branch and at the highest rate on record in the truck division. Although May will probably mark the peak of the expansion, the decline which is indicated for the summer months will not be so severe as that suffered last year. It is estimated that the end of 1925 will see close to 19,000,000 motor vehicles in the United States.

Building contracts let during April were $547,000,000 against only $480,900,000 in March and $480,100,000 in April of 1924. The building cost index of the New York Federal Reserve Bank, taking 1913 as 100, was 195 in March 1925. The index of building wages on the other hand was 217 at the same time, showing that the largest increase in building cost is undoubtedly the labor cost.

WHEELING STOCK EXCHANGE, MAY 22, 1925

Hazel-Atlas	33½	35	34½
Imperial	..	75	73
Fostoria	140	..	140
Central	93	95	105

Considerable activity in the Wheeling district is noted in Hazel-Atlas, which is operating about 70 per cent. The specialty plants have had some recession in activity.

TOLEDO STOCK EXCHANGE, MAY 22, 1925

Owens Bottle Machine, common.....	46¾	47	47
Libbey-Owens Sheet Glass, common.....	133	137	135
Libbey-Owens Sheet Glass, preferred.....	110	111	110

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers.

May 22, 1925

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	..
Antimony oxide (Sb_2O_3)	lb.	..	.16
Antimony sulphide (Sb_2S_3)	lb.	..	.16½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.05¼	.05½
Barium carbonate ($BaCO_3$)			
Precipitated	ton	..	..
Natural, powd.	ton	42.00-47.00	47.00-56.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05½
Bone ash	lb.	.05½	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04¾-.05	.05-.05¼
Borax, fused ($Na_2B_4O_7$) any mesh	lb.	..	.35
Boric acid (H_3BO_3)	lb.	..	.08½
Boric acid, refined	lb.	.09	.09½
Cadmium Sulphide (CdS)—Red	lb.	..	1.30-1.40
Orange	lb.	..	1.25-1.40
Yellow	lb.	..	1.25
Chrome Oxide (Cr_2O_3)	lb.	.32	.34
Cobalt Oxide (Co_3O_4)—			
In bbls.	lb.	..	2.10-2.20
In 10 lb. tins	lb.	..	2.20
Copper oxide—			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.25-.27
Black prepared	lb.	..	.35
Cryolite (Na_3AlF_6)	lb.	..	.09⅛
Feldspar—			
100 mesh	ton	12.00-14.00	16.00
80 mesh	ton	..	..
40 mesh	ton	..	..
Ferric oxide (Fe_2O_3)	ton	..	.02
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	..
Powdered white, 90%	ton	38.00	..
Hydrochloric acid, 20° (Carb. $5)	lb.	..	.01
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	..	.13-.13½
52% and 48%	lb.	..	.10-.11½
Kaolin (f.o.b. mine)	ton	9.00	..
English, ex. vessel	ton	14.00-23.00	..
Lead Oxide (Pb_3O_4) (red lead)	lb.	.11¾	.12
Litharge (PbO)	lb.	.11¼	.11½
Lime—			
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl.		2.15	2.30
Magnesium carbonate ($MgCO_3$)	lb.	.03¼	.03½
Manganese 85% (MnO_2)	lb.	.03½	.03¾
Nickel oxide (Ni_2O_3), black, for nickel content	lb.	..	.35
Nickel monoxide (NiO), green, for nickel content	lb.	..	.35
Nitric acid (38°) (Carboy $5)	lb.	..	.06½
Potassium carbonate—			
Calcined (K_2CO_3) 96%	lb.	.06½	.07
Hydrated 85%	lb.	.05¾	.06¼
Potassium nitrate (KNO_3) (gran.)	lb.	.06⅛	.06⅜
Potassium permanganate ($KMnO_4$)	lb.	.15	.16
Powdered blue	lb.	..	.24
Rochelle salts	lb.	..	.20
Salt cake, glassmakers (Na_2SO_4), f.o.b. works, bulk	ton	21.00-22.00	.01½-.02 lb.
Selenium (Se) black, powd	lb.	..	2.10-2.15
Red, powd	lb.	..	1.95
Silver nitrate ($AgNO_3$) 100 oz., per oz.		..	.47
Soda ash (Na_2CO_3) dense, 58%—		..	..
f.o.b. works.			
Bulk, spot	Flat 100 lb.	1.40	..
Bulk, on contract	Flat 100 lb.	1.35	..
In 400 lb. bbls., on contract	100 lb.	1.69	2.40
In 400 lb. bags, on contract	100 lb.	1.45	..
Spot orders .05 per 100 lbs. higher.			
Sodium nitrate ($NaNO_3$),			
Refined (gran.) in bbls	lb.	.03¾	.04
95 per cent	lb.	.02⅝	.02¾
Sodium selenite (Na_2SeO_3)	lb.	..	2.35-2.40
Sodium fluosilicate (Na_2SiF_6)	lb.	..	.04¾
Sodium uranate (Na_2UO_4)	lb.	..	1.30
Sulphur (S)—			
Flowers, 155 lb. bbl.	Per 100 lb.	3.35	3.65-3.90
Flowers, in bags	Per 100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls.	Per 100 lb.	2.50	2.80-3.05
Tin oxide (SnO_2) in bbls	lb.	..	.59
Uranium oxide (UO_3), 100 lb. lots	lb.	..	1.30
Zinc oxide (ZnO)	lb.	.08	.08¼

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to April 23, 1925

		March 1924 Quantity	March 1924 Value	March 1925 Quantity	March 1925 Value	Nine Months Ending March 1924 Quantity	Nine Months Ending March 1924 Value	Nine Months Ending March 1925 Quantity	Nine Months Ending March 1925 Value
Glass and glass products (total)		.....	$728,176	.....	$751,118	.....	$7,545,526	.....	$6,204,582
Plate and window glass—									
Window glass, common, box 50 sq. ft.		1,881	8,212	1,630	9,469	38,281	170,567	26,875	133,600
Plate glass, unsilvered, sq. ft.		165,045	44,793	130,028	26,718	1,209,939	480,615	1,155,098	300,577
Other window and plate glass, n.e.s.	lbs.	172,854	26,649	211,084	25,324	1,775,768	199,688	1,474,890	155,800
Glass containers (bottles, vials and jars)	lbs.	4,524,541	233,279	6,194,825	266,113	48,617,315	2,347,257	47,220,891	2,101,848
Table glassware, plain	lbs.	1,153,033	132,568	1,494,410	147,011	14,151,532	1,592,842	12,425,039	1,280,187
Table and other glassware, cut or engraved	lbs.	25,751	10,222	49,378	15,624	397,761	132,674	432,137	128,334
Glassware for lighting—									
Lamp chimneys and lantern globes	lbs.	217,494	36,867	172,301	27,970	1,525,922	285,994	1,454,964	246,946
Globes and shades for lighting fixtures	lbs.	125,887	37,931	176,042	44,355	1,310,349	358,499	1,123,863	314,654
Lamps and other illuminating devices, chiefly of glass	lbs.	77,571	20,105	77,313	19,922	1,115,225	286,830	661,526	189,760
Chemical glassware	lbs.	18,133	10,909	19,338	16,229	191,285	133,162	196,428	153,138
Electrical glassware, except for lighting	lbs.	189,555	20,343	310,779	20,627	1,913,869	154,753	1,449,641	159,105
Other glassware, n.e.s.	lbs.	1,041,763	152,298	828,096	131,756	9,099,762	1,402,645	4,993,099	1,040,633

IMPORTS

Corrected to April 23, 1925

Glass (total)		.....	$1,440,497	.....	$1,406,231	.....	$18,656,168	.....	$12,810,866
Cylinder, crown and sheet—									
Unpolished, lbs.	dut.	1,735,072	93,961	6,156,015	331,591	26,846,442	1,350,779	30,197,174	1,623,699
Bent, ground, beveled, colored, painted, etc., and polished	dut.	.....	56,599	.....	37,870	.....	564,283	.....	360,879
Plate glass—									
Unsilvered, sq. ft.	dut.	1,479,557	953,602	1,193,548	593,531	19,404,288	12,451,351	10,421,222	5,332,802
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft.	dut.	153,748	16,084	87,887	12,114	1,644,527	250,669	1,355,802	218,801
Containers—bottles, vials, etc.	dut.	.....	5,301	.....	25,377	.....	104,021	.....	135,684
Table and kitchen utensils, lbs.	dut.	39,056	11,013	12,604	3,922	636,523	136,954	462,906	114,417
Glassware, cut or decorated, lbs.	dut.	215,615	97,324	233,818	137,561	2,799,875	1,238,962	3,151,600	1,634,304
Blown glassware, n. e. s., lbs.	dut.	.....	.....	.....	.....	[3]3,402,894	[3]881,319	.....	.....
Bottles, ornaments, etc., lbs.	dut.	206,662	63,182	110,243	45,409	[2]497,985	[2]179,218	5,024,784	1,404,409
Bulbs or electric lamps, number	dut.	1,015,863	15,621	480,478	4,617	[2]1,851,210	[2]28,039	12,130,071	140,502
Chimneys, globes, shades, etc., lbs.	dut.	269,228	47,700	487,183	95,203	[2]890,689	[2]144,204	3,861,884	854,020
Articles and utensils for chemical, scientific, and experimental purposes, lbs.	dut.	67,855	25,236	80,290	26,888	[2]182,051	[2]71,891	690,110	244,090
Other glassware	dut.	.....	54,874	.....	92,148	.....	1,254,478	.....	747,259

[1] July 1, to Dec. 31, 1923. [2] Beginning Jan. 1, 1924.